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THE "D-1" GOING INTO THE NEW SUBMARINE BASE AT NEW LONDON, CONN., AFTER THE RECENT MANEUVERS

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A New Form of the Fighting Aircraft

By Robert G. Skerrett

DESPITE all that has been said to the contrary, the United States Navy, technically at least, is making material strides in the field of aviation. A short while since a seaplane was launched into the air by means of a catapult from the deck of the U. S. S. "North Carolina" while that cruiser was under way. This achievement blazes the way for the practical coöperation of aircraft and fighting ship when hundreds of miles or more at sea. It reasonably bids fair to modify radically the strategic problems of battle squadrons, especially so far as getting in touch with the enemy is concerned, and then planning the best way to force an action or to avoid one, as the exigencies of the moment require.

To be sure, aeroplanes have been launched from the decks of some of our vessels before, and at the Dardanelles the British have found their aviation ship, the converted merchant freighter "Ark Royal," extremely useful. But the "Ark Royal," like our own earlier ships used for aviation experiments, has been uniformly anchored in comparatively sheltered waters when the flying machines took their flights from her deck. Besides this, the machines have been small ones and of extremely limited endurance. Nevertheless, the air pilots, working from that base, have been able to serve the fleets well by marking the fall of shell hurled by indirect fire upon hidden enemy batteries. But this service is not identical with that of coöperating with a squadron at sea bent upon discovering the foe or intent upon covering the transportation of a large body of troops. What has lately been done in adapting Capt. Washington I. Chambers' catapult for use aboard a moving ship brings us measurably close to the wider use of seaplanes in concert with battle craft anywhere.

What was done aboard the U. S. S. "North Carolina" clears the way for still another radical application of big seaplanes. About three years ago Rear-Admiral Bradley A. Fiske, U. S. N., obtained a patent covering a method and an apparatus for delivering submarine torpedoes from airships. Briefly, his idea was to carry, slung below the flying machine, a moderately light, short-range automobile torpedo. When near enough to the enemy to make reasonably sure of scoring a hit, the seaplane was to swoop down close to the water, drop the torpedo, and leave that weapon to cover at full speed the interval between it and the target. This really embraced an amplification of coast defense, and the aeroplane was expected to start from the shore on its mission.

By perfecting the catapult it will be feasible to launch the so-called "flying-fish torpedo" from a speeding ship. It is a fact that a big destroyer can be detected at night farther away than it is practicable to locate an approaching aircraft. The destroyer must launch its torpedoes on their journey miles away from the target. On the other hand, a seaplane capable of carrying an automobile torpedo will stand a much better chance of scoring a hit, especially when the enemy vessels are moving, because it can get nearer undiscovered. But Rear-Admiral Fiske has amplified this novel form of torpedo warfare.

Inasmuch as seaplanes are now available that can lift heavy loads, he purposes transporting through the air bigger torpedoes than originally contemplated, and in this way to deal a more destructive blow against the improved under-water defense of the most recent of dreadnoughts. As the torpedo would not have to travel as far as one fired from the ordinary fighting craft, weight could be saved in its general design, especially in the motive department, and this means an increased explosive charge in the war head. But in order to reduce to a minimum the chance of missing, the latest scheme advanced by Rear-Admiral Fiske embraces a dirigible torpedo—one susceptible of wireless control.

There has been a characteristic weakness in dirigible torpedoes heretofore proposed. They could not be kept track of from the operative base for any distance when the air was hazy or the light dim: their employment after nightfall was practically out of the question. John Gardner of England, one of the most successful experimenters in this field of telautomatics, abandoned his labors, although he had accomplished much that should have encouraged him to go on. His reasons for droping the task have been thus explained: "There is now no great difficulty in governing the functions of a torpedo without tangible connections, and with reasonable freedom from interference; but the weapon, or some object carried by it, must remain visible to the operator throughout its run. Late years have seen a great increase in the range of ships' guns: it is possible that hostile ships will never get within four or five miles of each other. Obviously, a wireless torpedo, to be of use in such an action, must be visible to its controller at a distance of four or five miles. The simple fact is that no object that can be carried by such a small vessel as a torpedo can be seen at that range in anything but

(*Concluded on page 527*)

Launching a radio-controlled torpedo from a hydro aeroplane. Lights carried by the torpedo, but invisible to the enemy, permit of tracing and controlling the course of the projectile

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Unmuzzling Our Naval and Military Officers

THE persistent refusal of the Administration to make public the plans of the War College and the General Staff of the Army for the reorganization and enlargement of our military forces is the latest evidence that the civilian head of the Army is determined to follow out the Administration's policy of sealing the lips of our naval and military men and interposing a barrier between the people of the United States (who are literally thirsting for information, not merely on this but upon every subject pertaining to our national unpreparedness) and the only men who are qualified by experience and knowledge to give them that information.

The history of naval and military affairs in this country proves that, with few exceptions, the civilian heads of departments have betrayed an exaggerated sensitiveness regarding the prerogatives of their position as the mouthpiece of the departments over which they presided. This unfortunate and unjust attitude reached its climax at the opening of the present war, when an explicit embargo of silence was laid upon every ranking officer and placed upon his desk in printed form. No discretion whatsoever was allowed them; their lips were securely padlocked, and it was well understood that the slightest infringement of this order would be met with condign punishment.

Now this was done at the very time, above all others, when the people of the United States were most eager for information about the instruments of warfare, its practice, the strength and quality of the forces engaged, and the thousand-and-one subjects of fascinating interest which would be involved in the great World Struggle. It is well understood that there is much information of a secret and confidential character, relating both to our own naval and military establishments and those of the Powers at war, which, in the nature of things, can never be made known; but outside of this there is a vast amount of information of the kind which the public desires to have, and which our naval and military men would be only too willing to give, which is denied to the public because of this foolish and quite unnecessary embargo.

This raises the question as to whether the time has not arrived for the Administration to assume a more generous attitude to our naval and military officers, and treat them with the confidence and dignity which are due to men of their high professional attainments, strong loyalty and unquestioned patriotism. And, above all, it is high time that both Congress and the Administration should get rid, once and for all, of that time-honored and foolish old bugaboo of what it is pleased to call "militarism," which, as it affects the Army and Navy, takes the form of a belief, or suspicion, or whatever it should be called, that your military man is at heart a fire-eating swashbuckler, who is consumed with a burning desire to turn the United States into an armed camp and rush the country into war upon the slightest pretext.

Now, this attitude is largely traditional. It is an over-late survival of the distrust of military force as expressed by a large standing army, which manifested itself in the young Republic at the close of the War of the Revolution. It was reasonable and was to be expected in those times; but so far as the United States is concerned, it is utterly unreasonable to-day; for there is absolutely nothing in the record of the Army and Navy during the past one hundred and thirty years to indicate that either branch of the service has at any time desired to arrogate to itself an undue authority or concern itself with other than purely naval and military affairs.

In fact, the boot is altogether on the other leg. Politics has interfered at times outrageously with the Army, as Mr. Oswald G. Villard has shown so ably in a recent series of articles; but the Army and Navy, as a whole, have never concerned themselves with politics. And as to that other suspicion—that our naval and military men desire to impose upon the country an Army and Navy altogether beyond its requirements, and that it is their wish to cultivate an aggressive military spirit, all we have to say is that, after twenty years of intimate intercourse with officers of all ranks in the two services, we have failed to note the slightest trace of any such spirit. And as to the charge that our officers are at all times eager for war, because it would offer them exceptional opportunities for advancement, we do not hesitate—and we know whereof we speak—to denounce the charge as a most unwarrantable aspersion upon the professional integrity and the pure patriotism of the finest body of professional men in the country.

There is, to-day, a widespread demand throughout the country that the public shall be put in closer touch with its naval and military experts; that their lips shall be unsealed, and that the people shall have, at first-hand, the benefit of the advice and direction of the only men who are qualified to tell them just what kind of an Army and Navy they need, adequately to protect their vast and ever-increasing national interests. Our experts would like to speak to the country, and the country certainly wants to listen. It has grown very weary of having the recommendations of these experts pigeonholed, and of being presented, instead, with the half-baked and necessarily immature and more or less amateurish recommendations of some well-meaning gentleman who, only yesterday, and all his life, may have been either, let us say, a lawyer, a country editor, a professor or anything indeed but a student of naval and military affairs.

The Aeroplane Dreadnought

THERE remains one redeeming feature in the tragedy of the European war—the rapid development it has forced upon aviation. Although the paramount civilian demand of "safety first" had to take second place to speed, progress in the directions of capacity for high and fast climbing, great loads in fuel, bombs and armament (unless accomplished at the expense of solid construction), necessarily leads to safety as well. This is obvious concerning the fundamental military demand for a motor proof against failing above the enemy's lines; but extreme speed and rapid climbing call for many times the power needed for mere support, and in the many authentic reports of war aviators one feature stands out prominently—the wonderful control motors of one hundred horsepower and more, with their large propellers, give to a pilot under critical conditions. Evidently this military flying closely approaches the degree of safety demanded for the aerial automobile of the future. It is plain that a war flyer of to-day, in stormy winds, heeds the possibility of a fall about as much as a horseback rider in jumping hurdles. In dodging the enemy's fire, in the wildest tumble of aerial fighting, when no thought is left for any intricacies of flying, the machine responds like a thoroughbred. Pilots, while half unconscious and pain-crazed from mortal wounds, have covered forty miles. The contingency always dreaded is when a hit motor gives out before the machine has been put to a sharp glide.

Development in times of peace would demand only that this amount of control be attained by something cheaper than extravagant motors, and that any aeroplane, to be safe, need not come up to the fighter's "automobile racer" standard. Incidentally, it demands that an "aerial chauffeur" should be able to serve more than one or two passengers. The recent demand for great loads of armament—for aeroplane dreadnoughts—meets this demand perfectly. Very fortunately, the Curtiss experiments for a Transatlantic aeroplane and the Sikorsky "omnibus" had long paved the way for its present successful answering. The new German "battle-plane," with two fuselages, belongs to the same class; but there is an inherent feature in the "dreadnought" which is bound to advance the general navigation of the air, because it concerns safety—and "safety first" should be ceaselessly repeated to the sponsors of the commercial aeroplane. The "steady flight" of Sikorsky's craft gave such a favorable impression that, but for one reason—their dependence on never-failing motors—we should have seen many imitations before such motors yet became imperative. A Sikorsky with motor trouble is far worse off than a disabled Zeppelin. Few are the spots large and level enough to come down without breakage; and even more rare are those from which to restart. Motor trouble thus means in most cases tearing down the huge fabric and carting away the debris. Curtiss' big waterflyers are exempt from such dangers so long as they are above their element, and motor perfection will eventually establish the Sikorsky. Superposing more than two planes will also make "dreadnoughts" less cumbersome, more solid for the same weight, and less dependent on very large landing grounds. Another advantage is their wonderful inherent stability.

This could be more exactly described if aerodynamic laboratories, which have so minutely ascertained the action of steady air streams on small models, had attempted to shed some light on the mechanism of "gusts"—an all-important question for safety. It could hardly be very difficult to reproduce any variety of "gusts" in wind-tunnels by screens or blasts, ascertain their exact nature by photography, and accurately measure their effect on the center of pressure. Some of the results would certainly happen to coincide with natural disturbances.

Another obvious question, neglected by scientists, is beyond the wind-tunnel's scope, but is easy to investigate by attaching pressure gauges to the wings of full-sized machines. We refer to the influence of size on wing pressure. Both these problems enter prominently into the theory of the "dreadnought."

Undoubtedly the pressure per unit of surface for the same speed should increase with the size, because size obviously augments the thickness of the supporting air stratum—as plainly shown by the old rule that superposed wings should be spaced apart the length of the chord. Another practical proof is the fact that pictures show Curtiss' "America" is essentially a linear increase of a flying boat, which necessarily implies that, barring unpermissible decrease of solidity, weight has grown faster than surface. The Sikorsky looks, also, like an exaggerated albatross. Nevertheless, both these "dreadnoughts" are excellent lifters. Enlarging an aeroplane—other things being equal—makes the leverage offered to gusts grow with the linear dimensions, the surface with their square, and weight and inertia with their cube. The showing of the Sikorsky and the big Curtiss (as well as the stability of the comparatively big, standard, military 100-horse-power plane) makes it very probable that the still-unknown mechanism of gusts works in such a way as to make the small increase of leverage outweigh the squaring of the surface and the sort of cubing of the total pressure on the wing. Evidently a gust on a larger wing has its effect less increased by the greater width of wing offered, and still less by the greater thickness of the acting air stratum, than it is alleviated by the merely linear increase of leverage; while the resisting force, the inertia of the whole machine, grows with the cube of the dimensions. There is no doubt about the last-mentioned fact, because more linear increase of dimensions and cubic increase of weight make a dreadnought not even as strong as a smaller machine (owing to relative decrease of strength of materials). Hence, for the mammoth dirigible a new design is imperative.

The Beneficent Toad

THE toad has always been looked upon as loathsome, even poisonous. Yet modern medical research is extracting from toadskins remedies of the greatest value and the beneficent possibilities of these secretions have by no means been exhausted.

Quack remedies have long been made from the skins of toads and the Chinese still use such an extract, called "senso," as a cure for dropsy. A well-known remedy among the New England colonists for sprains and rheumatism was a toad ointment made as follows:

Four good-sized live toads; put into boiling water and cook very soft; then take them out and boil the water down to one half pint, and add fresh churned unsalted butter, one pound, and simmer together; at the last add tincture of arnica two ounces.

In the light of Dr. Abel's brilliant work these old remedies take on a new meaning. Abel studied the giant tropical toad, Bufo agua, found in the Upper Amazon. The natives of that section of Brazil make an arrow poison from the creamy secretion of the skin glands, a poison so powerful that it kills big game in a few moments. From this secretion Abel isolated adrenalin, a blood-pressure-raising medicine invaluable to the specialist and the surgeon. Previously this substance had been extracted from the suprarenal glands of the ox or sheep and later had been synthesized in the laboratory from coal tar as it was found to be nothing more than di-hydroxymethyl-aminoethylol benzene.

But the most valuable and startling part of Dr. Abel's work with this toad secretion was the isolation of a beautiful crystalline substance to which toadskin owes its curative powers for dropsy. This he named "bufagin," and the most active investigation of its properties is now in progress. It seems strange that after a century's ridicule of a toad treatment for dropsy as a mere grandmother's remedy we should now find a genuinely scientific confirmation of the practice. It may be objected that all varieties of toads do not give the same secretion as the giant toad from the Amazon, but it has only recently been found that another crystalline substance, bufotalin, of very similar properties to the bufagin, is found in the skin of the common European toad.

Radio Communications

Radio Operators are Enlisting in Great Numbers in the ranks of the belligerent nations of Europe. It is reported that in the British navy alone there have been over 5,250 radio operators who have enlisted. Among those serving on warships one has earned the Victoria Cross, one the Cross of the Legion of Honor, and four the Distinguished Conduct medals.

New Installations of Navy Department.—There are being installed on the roof of the State, War and Navy Building at Washington five wireless receiving and short-distance transmitting sets, which, when completed, will enable the Navy Department to communicate with vessels while in no way interfering with the Arlington station. Thus the newly created office of naval operations, over which Rear Admiral Benson presides, will be in direct communication with the fleet and with the Arlington station.

Proposed Radio Service Between New York and Buenos Aires.— An American wireless company has obtained a concession from the Argentine Republic government for the erection of a high power radio station at Buenos Aires, to be used for constant communication between that country and the United States. It is planned to erect 1,000-foot towers at both stations in order that the intervening distance of 4,600 miles may be covered under all conditions. The transmitters will probably be of 300 kw. capacity.

New Record for Radio Transmission.—On November 29th a radio operator of the Federal Wireless Telegraph Company, stationed at Honolulu, succeeded in intercepting messages sent out by the high power station at Nauen, near Berlin, Germany. At the time the German station was sending war dispatches, and so perfect was the reception of the signals that the Honolulu operator "copied" the messages without difficulty. The distance traversed by the signals was approximately 9,000 miles, establishing a new world's record in radio transmission.

Value of Radio Communication in Saving Lives.—During the fiscal year 1915 the radio inspectors of the United States Bureau of Navigation reported 26 cases of vessels leaving American ports which met with accident or disaster, requiring the use of radio communication to summon assistance. Four of these were from fire; 12 were from running ashore, stranding, or getting into an ice jam; 3 were from breakage of machinery; 4 resulted from collisions; 1 from shifting of cargo; 1 vessel was storm battered and water logged; and 1 was torpedoed. Excepting in the case of the "Lusitania," which was torpedoed, the assistance thus rendered resulted in but two lives being lost.

Wireless Telegraphy and the United States Navy.—A message recently sent by Secretary of the Navy Daniels to all commanding officers of the Navy, casts light on the influence of radio communication on naval affairs. It forcibly indicates that because of the advent of wireless telegraphy, enabling officers and Washington authorities to be in constant touch with each other, the officers no longer are compelled to exercise as much initiative as they did in previous years. The message follows: "Due to the ease with which the Navy Department can be communicated with from all parts of the world, no commander-in-chief, divisional commander, or commanding officer, shall issue an ultimatum to the representative of any foreign government or demand the performance of any service from any such representative that must be executed within a limited time without first communicating with the Navy Department, except in cases where such action is necessary to save life."

Interesting Facts on Earth Resistance.—Speaking before Section G of the British Association, E. W. Marchant has disclosed several interesting facts in regard to his experiments with earth connections for radio stations. In connection with his experiments made at a wireless station at Liverpool, three different types of "ground" were employed, viz., the water pipe system of the building, an earth connection formed of fourteen 2-inch cast iron pipes, pointed and driven about one foot into the ground, and a copper plate 1 foot 6 inches wide and 4 feet 6 inches long, buried vertically at a depth at the lower edge of 6 feet below the surface and connected to two copper strips laid at a depth of 6 feet, each 1 inch wide and 40 feet long. In the two latter cases the pipes and copper plates were laid directly in the earth, without a surrounding volume of coke such as is usually recommended. By certain methods and calculations the resistance of the three "grounds" was found to be as follows: Copper plate and strip, 6.1 ohms; iron pipes, 42 ohms; water pipes, 3 ohms. By reversing the current used in the measuring of the resistance, the results were: Copper plate and strip, 7.1 ohms; iron pipes, 40 ohms; water pipes, 2.7 ohms. Thus it will be seen that the water pipe system of a building comprises the best obtainable "ground," while a sheet of copper buried in the earth is a poor second.

Astronomy

M. Georges van Biesbroeck, adjunct astronomer of the Royal Observatory of Belgium, has become temporarily a member of the staff of the Yerkes Observatory, with the title of visiting professor of practical astronomy. The staff of the Belgian observatory appears to be widely scattered, though some of its members are, or recently were, still at the observatory, which is now under German control.

Movement of the Martian Canals.—With regard to the alleged shifting of the canals of Mars over the face of the planet Prof. Lowell states in *Popular Astronomy* that this phenomenon was detected at his observatory nineteen years ago, and is therefore no novelty. He believes that there is not an actual displacement of the canals, but that there are, in each case, several canals that become successively visible.

The Melbourne Observatory, which was founded in 1863 and is one of the well-known astronomical institutions of the southern hemisphere, will probably soon be closed. The veteran director, Mr. Pietro Baracchi, resigned last August, and no successor has been appointed by the government of Victoria, which has decided to abandon the work of this official observatory in order to save the expense of its upkeep, about $20,000 a year.

The Asteroid Aethra forms the subject of a recent note by Mr. Dinsmore Alter. This planet was discovered by Prof. Watson on June 10th, 1873, but has never been seen since twenty-two days after its discovery. Orbits were computed for it by Watson and Luther. Its orbit has been recomputed and the range of solution determined, but as this range is very large it is impossible to find the asteroid by means of a search ephemeris. A suspected observation of the asteroid at the Lowell Observatory in 1913, which can be reconciled with the orbit based on the observations of 1873, furnishes data by means of which it is hoped that Æthra will be rediscovered this year. This asteroid is famous for the eccentricity of its orbit, almost equal to that of a comet.

The Use of the Zodiac in Architectural Decoration is discussed by F. Boquet, of the Observatory of Paris, in a recent memoir on "Art and Astronomy." The signs of the zodiac are a common sculptural motive in Romanesque and Gothic cathedrals. They are found on most French cathedrals of the 12th and 13th centuries. In some cases no attempt has been made to arrange them in their correct sequence. This may have been the result of negligence or ignorance, or may have been due to a deliberate disregard of their symbolical character for the sake of producing an artistic effect. The zodiacal figures are also found in mediæval stained glass and in pavements. One of the most beautiful modern examples of their use is in the celebrated Fontaine de l'Observatoire, in Paris, where the zodiac is shown on an armillary sphere and is given its proper inclination to the celestial equator.

Sunspots and Terrestrial Temperatures.—The relations between sunspots and terrestrial temperatures were somewhat fully worked out by W. Köppen about 40 years ago, with the result that, in general, times of sunspot maximum were found to correspond with periods of deficient temperature, and vice versa, the parallelism being most marked for temperatures within the tropics. This conclusion is confirmed in a recent study by Dr. Gilbert T. Walker, director of the Indian meteorological service. Dr. Walker publishes correlation coefficients for a large number of stations widely distributed over the earth. The defect of temperature at sunspot maximum is found to prevail at a majority of stations, especially in the tropics; but in a large area stretching from the Arctic over western Europe the reverse relation is found to prevail.

Conditions of Life on Venus.—Mr. C. E. Housden, an English hydraulic engineer, published a few years ago a somewhat startling book on Mars, in which he furnished detailed information in regard to the system of pipes and pumping-stations whereby (in his opinion) the Martians are enabled to irrigate their arid planet. He has now produced a little *brochure*, entitled "Is Venus Inhabited?" in which similar engineering achievements are attributed to the problematical inhabitants of Venus. Mr. Housden sets out from the opinion of Schiaparelli and Lowell that Venus always turns the same face to the sun. Admitting the presence of water, this would result in one half of the planet's surface being permanently locked in ice, while on the other excessively hot and arid conditions would prevail. The writer assumes the habitable portion of the planet to be a zone of the sunlit hemisphere bordering the ice fields of the dark hemisphere. Melting glaciers from this ice would supply water, which, to prevent evaporation, the Venusians would convey in pipes rather than open channels to the places where they desired to use it. The book contains an extensive discussion of Venusian meteorology, and is plausible enough to be interesting.

Science

Marquis Raffaele Cappelli has resigned the presidency of the Reale Società Geografica in consequence of comments on his pro-German attitude, and *Nature* raises the question whether he will also relinquish his position at the head of the International Institute of Agriculture, which he has held since 1910.

Saponins, which are widely distributed among plants, possess the property of dissolving the red blood corpuscles. Some of these substances are extensively used in carbonated beverages to produce a heavy foam, and accordingly the Bureau of Chemistry has undertaken an investigation of the effects of their prolonged use by man, in connection with the administration of the Food and Drugs Act.

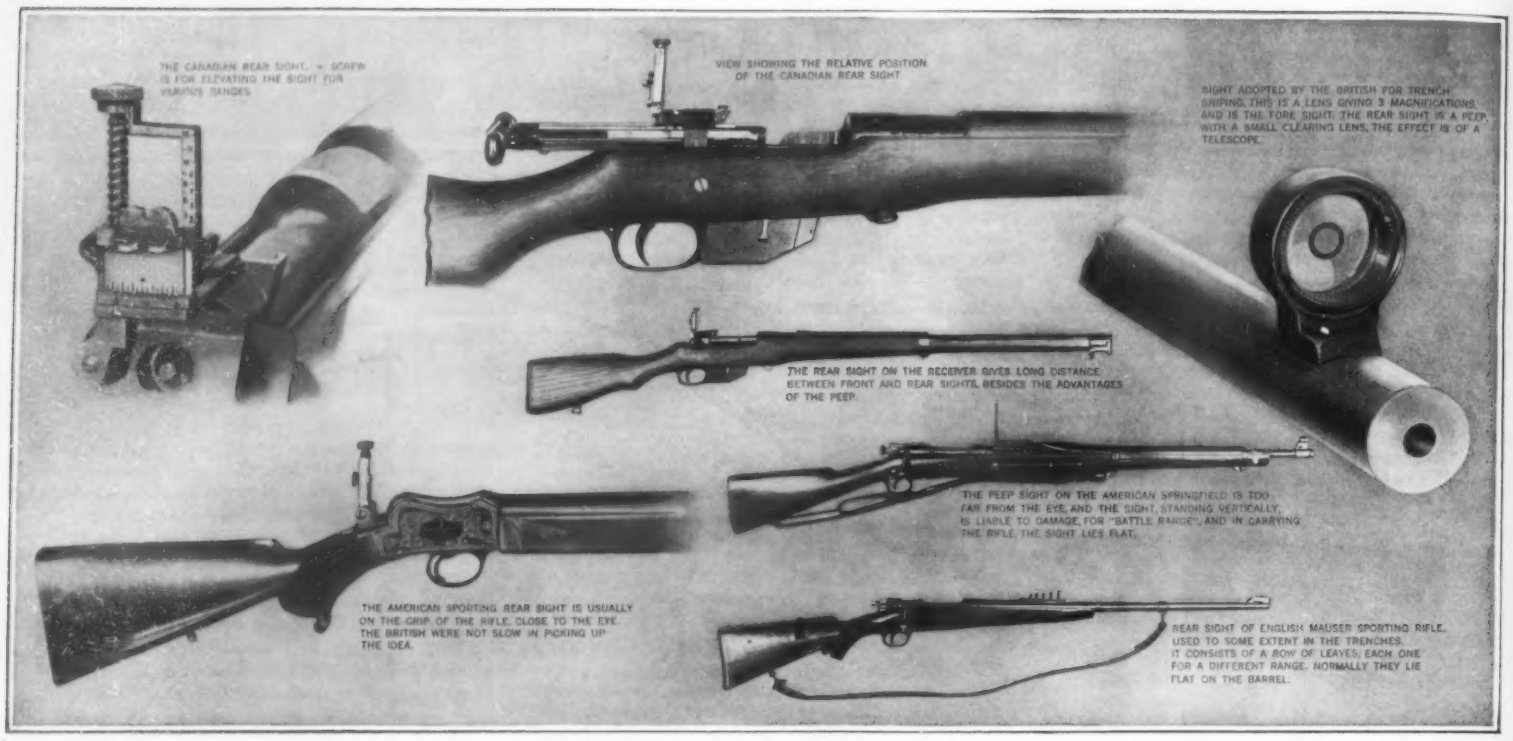
Ferns as Weeds.—Of the 200 species of ferns native to this country a few have become more or less serious weed pests. The most troublesome are the hay-scented fern and the brake. According to a recent bulletin of the Department of Agriculture, cutting off the tops close to the soil surface twice a year for two years will kill out nearly all ferns. The best times to do the cutting are just previous to sporing, or about the middle of June and the middle of August, in southern New York.

The Vitamines, those substances which are now regarded as so important in the diet as a preventive of diseases of the general nature of scurvy and beriberi, form the subject of investigations recently undertaken by the U. S. Bureau of Chemistry. The literature of the vitamines, though extending back only three years, has already grown to respectable proportions. Thirteen papers on the subject are listed in the latest volume of the Index Catalogue of the Library of the Surgeon-General's Office, and several others have been abstracted in recent volumes of the Experiment Station Record.

The Enormous Value of Rainfall to the agriculturist is set forth by Mr. E. J. Cragoe in the *Journal of Geography.* He calculates that the increase in the wheat crop in the Dakotas, California, Washington, Kansas and Nebraska for each inch of rainfall above four inches in May and June represents a value of about $15,000,000. The figures for maize are more impressive; one inch of rainfall above three inches in July in Indiana, Illinois, Kansas, Iowa, Ohio and Nebraska, increases the value of the crop by $160,000,000. Moreover, it was found that when the July rainfall averaged less than 3.4 inches the yield of maize averaged ten bushels less per acre than when it was more than 4.4 inches. This represents an increased value of about $250,000,000. No wonder grain speculators watch the weather reports with an anxious eye!

The Homing Capacity in Terns has been the subject of interesting experiments by Prof. J. B. Watson and Dr. K. S. Lashley, at Bird Key, Dry Tortugas, under the auspices of the Carnegie Institution. Birds were caught in their nesting places, tagged, marked with paint on head and neck, and carried in large cages to a distance, whereupon they were liberated and watch was kept for their return. It was found that "the noddy and sooty tern can return from distances up to 1,000 miles in the absence of all landmarks, at least so far as the term 'landmark' is understood at present." A return from the open sea was found to be effected as readily as from a place on the coast. Birds returned from Galveston, from Cape Hatteras, from Havana, etc. In these cases, however, a certain percentage did not return. The report on these experiments discusses various proposed explanations of the homing capacity in birds, without reaching any conclusion.

The History of the Tilefish (*Lopholatilus chamæconticeps*), as retold in a recent circular of the Bureau of Fisheries, is full of romantic interest. This fish was discovered in 1879, when a New England fisherman, Capt. Kirby, caught several thousand pounds of a "strange and handsomely colored fish" not far south of Nantucket, and sent a specimen to the U. S. Fish Commission, which found it to be a new species. The fish proved to have edible qualities of a high order, and to be present in enormous numbers within easy reach of the coast. Hardly, however, had measures been set on foot to establish tile fishing as an industry, when the species was apparently exterminated by a mysterious disturbance along the edge of the slope. In March and April, 1882, dead tilefish covered an area 170 miles long and 25 miles wide, and it was estimated that upwards of 1,400,000,000 had perished. The most plausible explanation of this disaster is that it was due to a displacement of the Gulf Stream. The tilefish is a bottom dweller and also requires a rather high water temperature. Apparently the Gulf Stream, receding from the shore, no longer extended downward to the shelving bottom, and the fish perished in the colder water which replaced it. After ten years, during which none of these fish were taken, the Gulf Stream returned to its old course, and the tilefish reappeared. It is now as abundant as ever, and the Bureau of Fisheries is trying to make its merits known to the public.



Various forms of sights used on military rifles

How a Rifle is Sighted

Quickness and Accuracy Obtained with the Peep Sight

A RIFLE that will shoot into a dinner plate at 500 yards for a score of shots, and a set of sights that are cruder than those used on the ancient crossbow—this is the modern military rifle and its equipment. The simplest form of rear sight in the world—the quickest to catch, and the most accurate to use, is a round hole in a plate close enough to the eye to save searching for it when the rifle is thrown to the shoulder. But two rifles of the world's military rifles are so fitted. One of these, the rifle of the American service, has the principle applied in so faulty a manner that for fighting the peep is nearly useless. It is set too far from the eye, and it is too small in size.

The sights on a rifle are necessary, first to allow the firer to see over the elevated muzzle, second, to aline the weapon accurately on the mark. Regardless of distance from the gun, if the mark is to be hit, the muzzle of the rifle must be pointing higher than the thing to be hit. At 1,000 yards the bore—the line of the barrel—is acutually pointing 40 feet above the target. During its flight the bullet falls this distance and hits the mark. This is true of the present Government rifle, but in the case of the old black powder .45-70, the barrel was actually pointed 175 feet above the mark at 1,000 yards.

By raising the rear sight, the rifleman can see over the raised muzzle, and when the front sight is put into the proper relation to the mark and the rear sight, the rifle is pointed the correct distance above the target to overcome the effect of gravity, and still the rifleman is aiming at the target over his line of sights.

When the Government rifle is sighted for 1,000 yards, the rear sight is roughly 5-16 inch higher than its position for 100 yards, and the muzzle of course has to be raised that much to bring the front sight again into line with the rear.

At this thousand-yard range, an error in the alinement of front and rear sight of just 6-1000 inch—six one-thousandths—will make an error at the target of 10 inches. In other words the rifle pointed at the center of a man's body, would miss him if the error of 6-1000 inch were made laterally, sideways. Four times this error in alining the sights up and down—24-1000 inch—would put the bullet above or below the soldier if the sights were pointed for his middle and the rifle were sighted to hit there when normally aimed.

This is the reason why the impracticable rifle shooters demand peep sights. It is the reason why the protests of thousands of American military rifle target shooters compelled the Government hastily to install an after-thought peep on the Krag Jorgenson of one model, why our Springfield has a peep, and why the Canadian Ross has a peep sight, a peep set in the correct position close to the eye, not true of any other rifle in the world that is intended for the fighting man.

The open sight is merely a bar with a notch cut in it, set usually near the rear end of the barrel. When the front sight is drawn into the correct position in this notch, and then the front in turn is placed in the correct relation to the mark, the rifle is sighted correctly. Unhappily this process entails optical impossibilities, and a compromise, more or less satisfactory, has to be used with the open form of sight.

The mark, the front sight, and the rear sight lie in three different planes. The eye sees no two of the three sharp at the same time. The rear sight, for example, lies say 15 inches from the eye, the front sight 30 inches, and the mark a distance measured in yards. So the unhappy user of the open sight has to make his eye leap sprightly from one sight to another and then to the mark, the muscles of accommodation altering the focus of the eye for each one as one alters the focus of the lens of a camera for varying distances.

Normally the shooter sees the rear sight sharp for an instant, as he draws the front sight into the notch, then trying to hold the front sight in its correct position, he focuses on the front sight and puts that against the mark, and then focuses on the mark. By this time the rear is very blurred and fuzzy because the eye is not in focus for something 15 inches away, but for infinity of distance. The great change, of course, is from front to rear sight, because changing in focus for an object 15 inches to one of 30 inches, is a far greater strain than changing from 30 inches to 300 yards.

Not only do old eyes, with stiffened muscles of accommodation fail to get accurate results with open sights, but young eyes cannot do the work with the open that they can with the peep. Into this list must be added the further evil that an excited man will not stop to draw the front sight into the right position in the notch of the rear sight, but will put it merely into approximate position, and let fly. It is an eye strain, and a slower method than the peep, but still the Continental authorities cling to this crude sighting method.

The peep sight, on the other hand, depends on a sound optical principle for its usefulness, and that the principle is sound is proved by too many years of the use of this form of sight. Crossbows dating clear back to the 14th century show peep sights as part of their equipment, one example belonging to an English nobleman, showing five different peep holes, one above the other for different ranges.

The light in the center of the round hole close to the eye is stronger than the light around the edges, and the eye, if left to itself, goes to the center of this hole every time. Queerly enough if the hole in the peep is about the size of the iris of the eye, the rim surrounding the hole in the sight, nearly disappears from view, even though it be 1-16 inch thick or even more. The well-known Lyman sight for sporting rifles illustrates this latter form.

If the rifle is such and the peep is so arranged that it can be used close to the eye without recoil endangering the shooter's face, a very small peep, 3-100 inch across, can be used, and still allow a perfect view of mark, country around it, and front sight. Here it is like looking through a pin hole in a sheet of paper against the eye. Also the small hole tends to act like the diaphragm of a lens, sharpening the image brought to the eye.

In using the peep set in proper position with relation to the eye, it is utterly ignored and is seen no more than a person sees the frame of the window through which he is gazing. The eye goes to the center of the hole if left alone. So the problem of our rear sight is immediately solved, the shooter has left only the front sight and the thing to be hit. Also not only does the shooter ignore the peep, but he does not have to fight with a blurring image of the rear sight in his endeavor to shoot accurately. So our gain is two-fold, quickness in sighting, and accuracy in sighting, to say nothing of the relief given to men with defective eye sight, or with the failing eyes of age.

The shooter's problem is resolved to the simple one of putting the clearly seen front sight in the correct relation to the mark. He has no more worry over seeing through the rear sight, once his head is in the correct position, than he would have did no rear sight exist.

But one military rifle correctly solves the sighting problem, and that is the Canadian service rifle, the Ross Mark 111. Here the rear sight is set back on the bridge at the rear end of the receiver, and is hardly 3 inches from the eye.

Normally the sight lies flat on the bridge, when a large "U" shaped notch forms the sight, and gives the rifle about 400 yards of range. This is the "battle sight," used at close range in a very great hurry.

When the leaf is raised to the vertical, a plate carrying the round peep hole is exposed to view. Above the round hole is another U notch for occasions when the peep cannot be used, such as very bad light and badly defined objects. For target shooting considerations the hole is very small, about 6-100 inch, and in poor light the rifleman cannot always use it. It would be more practical for sighting if opened out to a tenth-inch diameter. As it is, however, it is so near to the eye that the rifleman sees through it without effort in ordinary lights.

The other rifle fitted with a peep, the new Springfield of the American service, loses all the virtues of the peep by the sight being set too far from the eye. With the largest size hole but 6-100 inch, the sight is perched on the rear end of the barrel, about 10 inches from the eye, and only by strain and care can the small hole be seen, and the mark caught through it. It is not practical for fighting, particularly in bad light, or on neutral colored objects. The peep is somewhat useful for target work, even a poor peep being superior to an open sight.

(*Concluded on page 526*)

Method of underpinning used in jacking up the Schwab homestead, so as to pass over the surrounding clump of trees

A portion of the trestle work that was erected in order to move the Schwab homestead across a deep valley

Difficult House-Moving Feat to Save Trees

AN unusually difficult problem confronted the house-movers to whom was assigned the task of moving the old homestead of Charles M. Schwab, the steel manufacturer, from its site near Loretto, Pennsylvania, without cutting down or in any way harming the cluster of trees surrounding it. Neither were the house-movers permitted to demolish the beautiful frame house, known as the "Immergrun;" it being the explicit wish of the owner that the house was to be removed in its entirety to another site, so that a new million-dollar summer home could be built in the center of the belt of trees. When Mr. Schwab first brought the matter of removing his Loretto homestead to the attention of the engineers, they studied the problem with great care, and later submitted a plan calling for the sacrifice of three trees. To this proposal Mr. Schwab is said to have replied: "Woodman, spare the axe. I would no more think of cutting down those trees than I would of killing the old cow to get a steak. All you have to do is to jack the house over the trees. It is only 30 feet."

No alternative being offered, the engineers settled down to the task of jacking the frame house over the trees. By the route that has been selected, it will be necessary for the building to pass over 23 trees before it reaches the road where it can be moved in the conventional manner. The maximum height to which the house will be jacked is 34 feet. Its journey will also include the crossing of a deep valley on the Schwab farm where it will find its new resting place. The total distance traveled by the house will be about 1,000 feet.

Labor-Saving Equipment for Concrete Road Building

POSSESSING many advantages, prime among which are time- and labor-saving, there has been introduced a complete, self-contained equipment for the construction of concrete roads.

Under its own power, the concrete road building equipment can be run to the site where the work is to be undertaken. Upon reaching the scene of activities, it is ready to begin work as soon as the necessary connections to a water supply system have been made. The plant is provided with a vertical steam engine which supplies the motive power for operating the concrete machinery, as well as for propelling the equipment when in transit. Both the steam engine and its boiler, as well as the fuel supply, are carried on the truck, so that the equipment may be said to be self-contained with the single exception of the external water supply.

The concrete batch is mixed in the usual way in a large, revolving drum; the materials being supplied in their proper proportions with a minimum of labor. In front of the concrete mixer, just above the delivery chute, there is hinged a long arm extending horizontally from the equipment. On this arm travels a carrier which is provided with hinged doors on its underside, so that the contents may be dumped at any desired place. The carrier is moved back and forth by means of a cable arrangement and drum, driven by the steam engine; the power being applied through a clutch fitted with a hand lever.

In actual operation, the materials for the batch are delivered by the laborers into a large pan which is then raised by means of cables through which the engine power is applied, causing the materials to slide into the mixing drum. Water is then introduced until the mixture has the required consistency. The carrier is then moved into position directly below the chute to receive the prepared batch, after which it is run on the horizontal beam to the spot where its contents are to be dumped. The saving in time and labor effected by the carrier system is immediately obvious.

Concrete-road-building equipment, showing the carrier with its hinged doors open, immediately following the dumping of the batch

The Current Supplement

GERMAN Potash Salts, with illustrations showing the interiors of some of the mines, is a timely topic in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2084, for December 11th. Another valuable article *On the Structure of the Universe* appears in this issue, a discussion of some of the ultimate objects of stellar astronomy. Another article of interest to astronomers treats of *Zodiacal Light*, and its place in the solar system. A short illustrated article on *A 5,000-Volt Direct Current Electric Railway* tells the important facts in relation to trolley lines where a very high voltage is being demonstrated, with apparent success. *Motor Fuels* gives some interesting facts in relation to the characteristics of a perfect fuel. One of the significant innovations of the present war is the new way of using artillery by firing at high elevations, and thus attaining a much greater range than was previously considered practical. The article on *Modern High Elevation Artillery* tells something of the new methods and of the new types of guns used, and there are a number of appropriate illustrations. The introduction of the jitney, and of gasoline busses, has raised many new problems for the operators of trolley lines, important not only to the owners of the lines but to the public as well. Some of these problems are discussed in the article on *Economics in Operating Small Cars*. *Suggestions in Mechanism* describes and illustrates some curious operations that can be performed with a circular saw, and will interest the mechanically inclined. *Effects of Shell Fire* tells about the results from the use of different kinds of shells, and is accompanied by descriptive illustrations. One of the valuable applications of the electric current is for the welding of metals, which it makes possible both in the shop and also out of doors, and of a multitude of purposes. This subject is fully treated in an unusually comprehensive article that should be of great value and interest to many people.

Electric Furniture Rubber

THE human furniture-rubber may increase his labor output five times, it is claimed, by the use of an electric rubber which has been recently put on the market. Hand rubbing, which is generally resorted to at the present time in finishing all good furniture, is hard work and requires a rather high class of labor so that it enters very largely into the cost consideration of the article being made. The electrical rubber has but to be intelligently guided and it will perform the work in a manner sometimes superior to that of the hand worker. It is more rapid for the reason that it makes about 400 strokes per minute, which is much faster than it is possible to move the human hand. The rubber consists of a completely enclosed motor of one fourth horse-power which is mounted on a substantial base and supplied with two handles by which its movement over the surface of the wood is controlled. A flexible cord connection carries the power from any convenient lighting socket, and mounted at a point near at hand is a switch for controlling the motor. The base of the device is oblong in shape and at each end are two felt pads which are rapidly oscillated when the motor is in operation. For rubbing, the pads are removed and covered with emery cloth or sand paper of the desired quality and the surface of the wood is cut away as the device is passed over it. Because of its shape it may be worked right up into corners, and is said to be particularly efficient in working over large, flat surfaces.

Immense Car Ferryboat on Lake Ontario

THE largest car ferryboat on Lake Ontario, built at Toronto, Ontario, has recently made its initial trip between Cobourg, Ontario, and Charlotte, the port for Rochester, N. Y. The new boat, known as "Ontario No. 2," is a companion vessel to "Ontario No. 1," though a trifle larger; "No. 2" being 318 feet long, 54 feet wide, with a rated capacity of 5,567 tons. It can carry 30 loaded freight cars and 1,000 passengers.

Strategic Moves of the War, December 4th, 1915

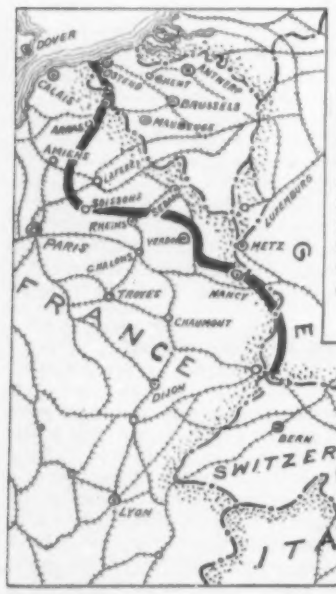
By a Military Expert

THE world awaits with interest the aftermath of the Serbian campaign with its bearing upon the general situation. With practically all Serbian territory under domination of the Teutonic alliance, with the railway from the Central Empires cleared through to Constantinople for the passage of much-needed munitions, even under a possible threat of severance by the Entente, great present importance attaches to the completion of the campaign and the definite restriction of the Entente troops to approximately their present line.

There must be a fundamental reason for this campaign to push through to Turkey. It has been variously ascribed to the necessity for replenishing the depleted reservoirs of war munitions of the forces holding the Dardanelles, a growing shortage of food in Teutonia proper requiring the unlocking of food reserves believed available in Turkey, and the theory that opportunity presents itself for a stroke at Great Britain's empire in Egypt and India. But in the opinion of many who have studied the situation seriously, the real *raison d'etre* of the campaign is believed to lie solely in the acquisition of more territory with which to bargain and barter when peace terms are tentatively broached. And it is probable that if the way to Constantinople is definitely secured, preliminary overtures for a discussion of peace will be forthcoming soon afterward.

It is practically useless to detail the local operations that have marked the Serbian campaign. Names mean little, so constant is the shift of *locale* that it is sufficient to understand that Serbia is practically cleared of defenders except for a very narrow strip in the west and south, while Entente forces are striving to strengthen their threatening flanking forces near Strumitza, on the Serbian-Bulgarian border, which are seeking to cut the railway to the Ottoman empire, through Bulgaria. It is possibly more interesting, therefore, to consider the relation of all the continental theaters of war to each other and the situation in general.

Diplomacy is now out-thundering the guns of war. Roumania and Rome are the local diplomatic battlegrounds, and the massing of Russian strength near the Roumanian border is doubly a promise and a threat of coercion. Before Roumania will declare actively for the Entente, Czar Nicholas must undoubtedly promise an ample force to protect Roumania from devastation, for the hammer of Austria-Hungary lies to the northwest, with Bulgaria the anvil, embracing the entire southern frontier. Between the two, Roumania without adequate assistance would be pounded to a pulp. Despite the strong Germanic influences at work in the administration, Roumania, slavic in sympathies, apparently favors the Entente cause, but fear for her own safety accounts for her indecision. Time is an important element in warfare. Should Roumania decide within a reasonable time to throw in her lot actively with the Entente, it might still cause difficulty in realization of the Teutonic plans for coupling the distant elements of the Alliance effectively. Yet, if Roumania finally takes this step, which dispatches seem to indicate she will do, there may be a trifle of bitterness in the natural query of the Entente, "Why could it not as well have been two months sooner?" Bulgaria would have been held in place and the comparatively slender attacking forces for which Teutonia has been compelled to rob her other battle lines, would alone have proved inadequate for the conquest of Serbia's difficult terrain.



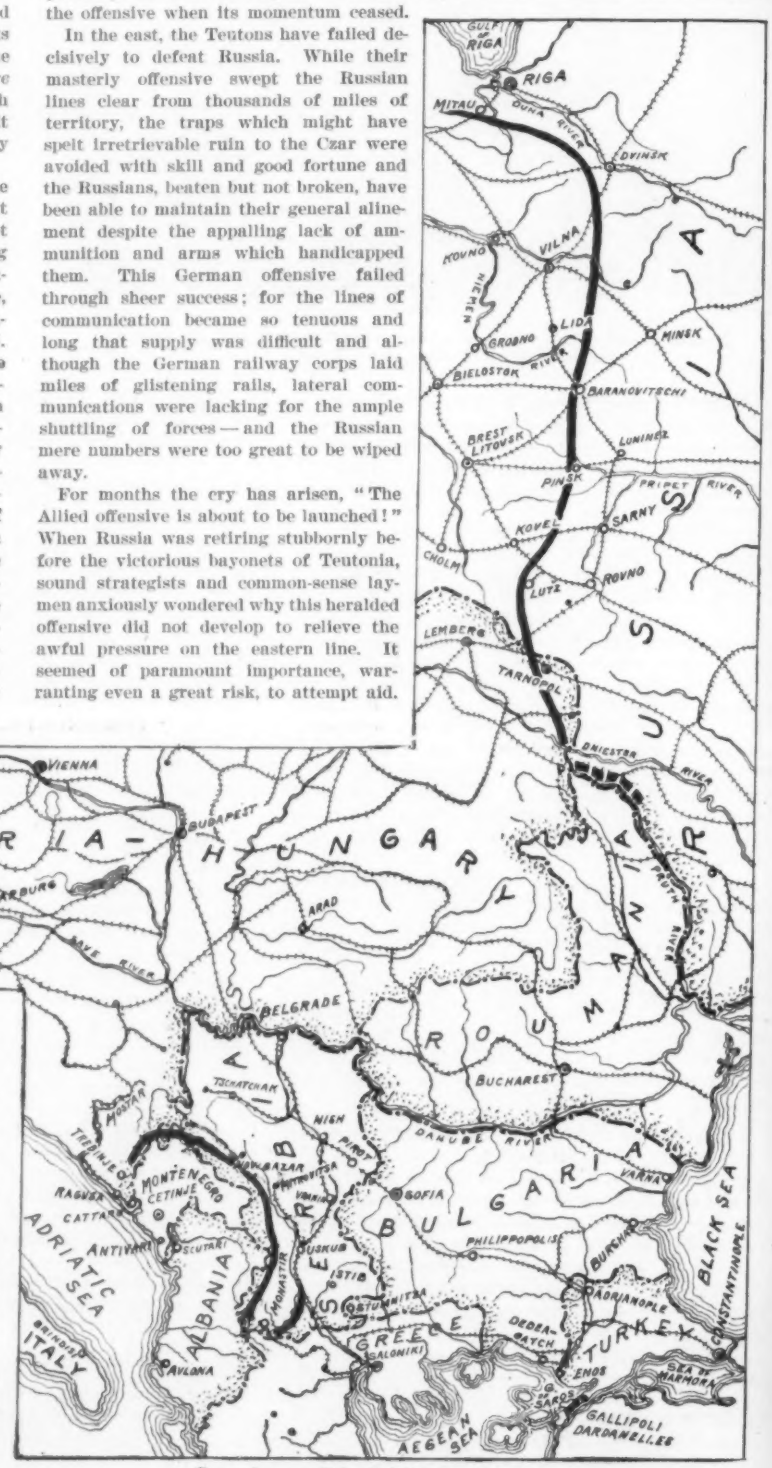
Egypt's defensive line

The second diplomatic battleground, Rome—possibly, more correctly, the Vatican—seems to constitute a theater for consideration of a doubtful psychological problem of the effect of gruelling warfare on the mind of sentimental mankind, blended with a possibility of securing to Italy local fruits of war without further expenditure of blood and treasure. It is reported that, following the personal visit of the Kaiser to Vienna, pressure is being brought to bear on the Pope for using his good offices to open peace negotiations with the warring powers, ostensibly in the cause of humanity. The Austrian newspapers presage the fall of the great fortress of Gorizia. This point is esteemed a key to the section and even the preponderant advantage of the defensive seems unequal to the task of coping with the vigor and strength of the Italian assault. Before these lines see print, Gorizia may have fallen. There is sufficiently more, reading between the lines of the Germanic press, to warrant belief that, to purchase Italy's withdrawal from further operations, Teutonia might now be willing to cede the debated territory demanded by Italia at the beginning of the war. With Italy out of the way, strong Austrian forces much needed elsewhere would be released for operations on another front. The question remains—"Would Italy accept?" Under the terms of alliance, Italy is precluded from making a separate peace. It would hardly appear sound policy for Italy to accept this for, with Teutonia strengthened thereby, the increased prospect of ultimate Entente defeat could not be regarded by Italy in these days of "Scraps of Paper" other than apprehensively. It seems not to warrant belief in permanence.

A deadlock obtains on the western line. Massed attacks by each side have failed to break it except locally. And even were France and England willing to utilize all their present strength and could clear France and Belgium of invaders, the cost in men would be so heavy that, holding grimly to other lines, Teutonia would probably be able to engineer another impressive shift of forces and crush the offensive when its momentum ceased.

In the east, the Teutons have failed decisively to defeat Russia. While their masterly offensive swept the Russian lines clear from thousands of miles of territory, the traps which might have spelt irretrievable ruin to the Czar were avoided with skill and good fortune and the Russians, beaten but not broken, have been able to maintain their general alinement despite the appalling lack of ammunition and arms which handicapped them. This German offensive failed through sheer success; for the lines of communication became so tenuous and long that supply was difficult and although the German railway corps laid miles of glistening rails, lateral communications were lacking for the ample shuttling of forces—and the Russian mere numbers were too great to be wiped away.

For months the cry has arisen, "The Allied offensive is about to be launched!" When Russia was retiring stubbornly before the victorious bayonets of Teutonia, sound strategists and common-sense laymen anxiously wondered why this heralded offensive did not develop to relieve the awful pressure on the eastern line. It seemed of paramount importance, warranting even a great risk, to attempt aid.



General map of the fighting fronts in Europe

Yet the broad, concerted attack did not develop. Why? Apparently it was the faith of those in authority, while Great Britain slowly gathered her strength, that Russia was too vast, too numerically powerful to be defeated decisively, destroyed, at the time. The French staff has played a waiting game from the first. Declining invitation after invitation to come forth and essay a trial in the open against the western German lines, the trick was uncovered—and the powers refused to be coaxed.

The Russian campaign might have been prosecuted further, except that a possibility of Allied success in Turkey threatened to eliminate a factor of Teutonic strength and open a way into Russia for supplies. The situation required a more solid welding of the parts of the Teutonic alliance.

This faith, then, clung. Munitions were sorely needed by Russia. The Allied attempt to open a way through Turkey failed and other methods of filling the empty arsenals and magazines became necessary. Behind the battered lines of the Czar,

(*Concluded on page 526*)

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

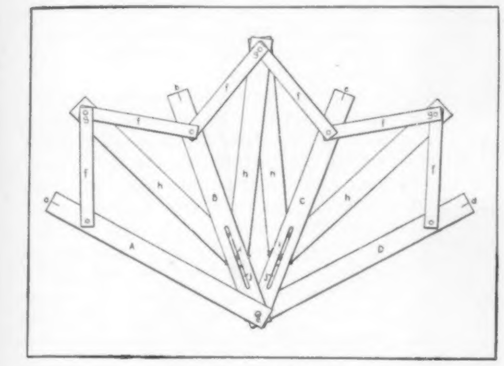
Mechanical Trisector

To the Editor of the SCIENTIFIC AMERICAN:

It is obvious that if four strips of thin material, pivoted together at one end, can be made to open and close, fan-wise, uniformly, the centers of the ends of the strips, when the two outermost ones are made to coincide with the sides of the angle, will indicate the points of trisection of the angle.

Four thin strips, A, B, C, D, of any suitable material, about 8 inches long, are pivoted together at a point e, about half an inch from the ends, and the ends a, b, c, d, are bisected.

At a point about 1½ inches from the ends a, b, c, d, the four strips A, B, C, D, are connected by six short strips f, f, f, f, f, f, about 4½ inches long.



A mechanical trisector

The pivots g, g, g, bisect the angles, aeb, bec, ced, but as the strips, AB, BC, CD, can move independently of the others the pivots, g, g, g, are connected by four strips about 8 inches long, h, h, h, h, with B and C by means of two pins i, i, sliding in longitudinal slots, j, j, in B and C.

This arrangement causes the four strips, A, B, C, D, to move uniformly when the device is opened or closed.

When the trisector is used the pivot e is placed to coincide with the vertex of the angle to be trisected. The bisection a is placed over one side of the angle, and the trisector then adjusted until the bisection d coincides with the other side of the angle, when the bisections b and c will trisect the angle.

ERNEST BERKEL.

Fort Logan, Colo.

Multiplicity of Claims in Patent Applications

To the Editor of the SCIENTIFIC AMERICAN:

In the revised *Rules of Practice* in the Patent Office, soon to be put into effect, a very helpful rule would be one to prevent the presentation and prosecution of unnecessary claims. Excepting Patent Office officials and examiners, no one probably realizes the large amount of work cast upon the examiners, in the examination of four or five times the number of claims actually required to cover all the novel subject matter. But not infrequently, in some classes of inventions, 200, or 300, or even more claims are insisted upon. In the present highly-developed arts, and with the lines of division between separate and distinct inventions well defined, it is difficult to conceive of a single invention, so novel, so complex, or so comprehensive, that all the novelty therein can not be adequately claimed in a much smaller number of claims.

The claim is the examiner's unit of work in his every official action in an application. In general, the greater the number of units of work required per application, the less the number of applications acted on each week, and in consequence, the slower the reduction in the whole number of pending cases. If an ample rule could be framed and equitably applied to limit the claims to such a number only as are actually necessary for full protection, the work of the examiners per application would be materially reduced.

The following figures will aid in emphasizing the need of such a rule. It is safe to say that each examiner employs at least one half hour out of every seven to pass on unnecessary claims. Counting 350 examiners this represents 175 hours of wasted effort per day, the equivalent of the work of 25 examiners. Very probably, however, the time so wasted is more nearly one hour out of every seven, the equivalent of 50 examiners, or approximately the work of seven examining divisions. In January of 1915, there were issued 3,480 patents carrying 23,740 claims, an average of a little over 6.8 claims per patent. In January of 1875, there were issued 957 patents containing 1,997 claims, an average of a little more than two claims to a patent. The size of patents, measured by the number of allowed claims, has been multiplied by three when compared with those of 40 years ago.

Opinions are fairly agreed that only about one half of all claims presented and prosecuted are finally allowed. On this basis, in the patents issued in January of the current year, at least 20,000 claims were canceled from the applications. In other words, the unnecessary work of examining these canceled claims was cast upon the Patent Office, which work might be very materially reduced, if the new rules should provide specific authority under which to proceed in extreme cases.

N. M. W.

Washington, D. C.

Telegraphic Cryptogram

To the Editor of the SCIENTIFIC AMERICAN:

There are innumerable systems of cryptography, but of all the articles and treatises I have ever read on the subject, and, as a devotee of cryptography, I may say that I am quite familiar with the numerous methods and devices employed, I have yet to find one based on a telegraphic code, and under the impression that it may be an original, or at least novel, idea, I venture to offer it for publication in your valuable columns.

The Morse telegraph code, on account of the employment of spaces between the

MORSE CODE

A	. —	N	— .
B	— . . .	O	. .
C	. . .	P	. . . . .
D	— . .	Q	. . — .
E	.	R	. . .
F	. — .	S	. . .
G	— — .	T	—
H	. . . .	U	. . —
I	. .	V	. . . —
J	— . — .	W	. — —
K	— . —	X	. — . .
L	——	Y	. . . .
M	— —	Z	. . . .

constituent characters of the letters *c, o, r, y* and *z*, is quite unsuitable for the purpose, but the Continental Code, or General Service Code of the United States Army and Navy, in which the confusing space letters are eliminated,

CONTINENTAL CODE

A	. —	N	— .
B	— . . .	O	— — —
C	— . — .	P	. — — .
D	— . .	Q	— — . —
E	.	R	. — .
F	. . — .	S	. . .
G	— — .	T	—
H	. . . .	U	. . —
I	. .	V	. . . —
J	. — — —	W	. — —
K	— . —	X	— . . —
L	. — . .	Y	— . — —
M	— —	Z	— — . .

will lend itself readily to our use. The Myer Code, formerly in use in the Signal Corps, a technical branch of the United States Army, might also be employed.

MYER CODE

A	22	N	11
B	2112	O	21
C	121	P	1212
D	222	Q	1211
E	12	R	211
F	2221	S	212
G	2211	T	2
H	122	U	112
I	1	V	1222
J	1122	W	1121
K	2121	X	2122
L	221	Y	111
M	1221	Z	2222

In order to avoid the occurrence of such combinations of characters as are represented by the letters *aa, mm, im, na*, in immediate sequence, for which there is no equivalent letter, and to utilize the entire sixteen four-character combinations, the necessity for which will appear later, the four two-character combinations representing *a, i, m, n* are eliminated, and the four surplus four-character combinations substituted.

CIPHER CODE

A	. . — —	N	— — — —
B	— . . .	O	— — —
C	— . — .	P	. — — .
D	— . .	Q	— — . —
E	.	R	. — .
F	. . — .	S	. . .
G	— — .	T	—
H	. . . .	U	. . —
I	. — . —	V	. . . —
J	. — — —	W	. — —
K	— . —	X	— . . —
L	. — . .	Y	— . — —
M	— — — .	Z	— — . .

The following table of the possible combinations will demonstrate that there are thirty possible ones, and as there are twenty six letters in the alphabet the four two-character combinations are dispensed with.

.	. .	. . .	. . . .
—	. —	. . —	. . . —
	— —	. — —	. . — —
	— .	. — .	. . — .
		— . .	. — . .
		— . —	. — . —
		— — —	. — — —
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			— — . —
			— — — —
			— — — .

When it is desired to encipher a message or communication of an unusually confidential or important nature, the message is first written in the characters of the code. The sentence, "The Germans are advancing on Paris," would thus appear:

— . . . . . — — . . . — . — — — . . . — — — — — — . . . . .
— — . — . . . . — — — . . . . . —. . — — — — — — . — . . —
. — — — — — — — . — — — — — — — . . — . . . — — . — .
. — . — . . .

The second step is to begin at the end of the sentence, expressed in characters, and, working backward, point or mark off the characters, in groups, as represented by the number of characters in the letters of the sentence.

The figures expressing the number of characters in the letters of the sentence are:

1413134443431434444433444343

and the characters of the sentence, when pointed off in reverse order, would stand in groups as follows:

3434443344444341343444313141

and would represent the letters

DVDIZJOSALABTJOFEKNGNMZWEDTLE

or the cipher to be transmitted.

The deciphering is accomplished, of course, by reversing the process.

The cipher can be applied to whole sentences, paragraphs or messages as prearranged, or to each individual word, and the letters of the code can be changed at will.

It will be observed that the number of letters in the cipher is always the same as the number in the sentence, which serves as a check on the correctness of the cipher.

ERNEST BERKEL.

Fort Logan, Colo.

"America as Her Own Chemist"

To the Editor of the SCIENTIFIC AMERICAN:

In your article on page 302 of issue of October 2d, the figures given in columns two and three are badly in want of recasting. "Three tons of cherry pit volatile oil" are only 600 gallons and "134 tons of fixed oil" only 26,800 gallons. Farther on "from 1,250 tons of apricot kernels" your article states that "from 18,000 to 22,000 tons of volatile oil are obtained;" probably, gallons are meant.

I think that it would be very much better if, in articles of this description, the method of stating the yields in parts per thousand were adopted. For people who, like myself, are accustomed to both the decimal and English systems of calculating yields, the proposed system may not mean much, but I have in mind those who are only accustomed to the decimal system. To them it would make the article intelligible, while to those using the English system no appreciable difference or difficulty would be caused.

A. GEORGE BYARD.

Bilbao, Spain.

How to Carry the Watch

To the Editor of the SCIENTIFIC AMERICAN:

I note your very interesting remarks in the issue of November 6th regarding a better method of carrying the watch. I suggest that the following be tried:

Make a pocket somewhat similar to that used to carry a wrist watch, but attach it to the left coat sleeve about 2 inches above the elbow, with the twelve forward, and the center of the watch slightly forward of the center of the arm. Fasten this pocket to the sleeve by the means that suit you best, presumably a good and inconspicuous form of safety pin.

In touring, it is actually easier to consult than the wrist watch, and is not subject to the severe vibration communicated to the wrist by the steering wheel. Nobody can accuse you of femininity when your watch is so worn, and it can readily be transferred from one coat to another.

ROBT. G. PILKINGTON.

Chicago, Ill.

Relics of Ancient Costa Rica

Metal-Working Methods of Primitive Central American Artisans Disclosed by Recovered Ornaments

By Walter L. Beasley

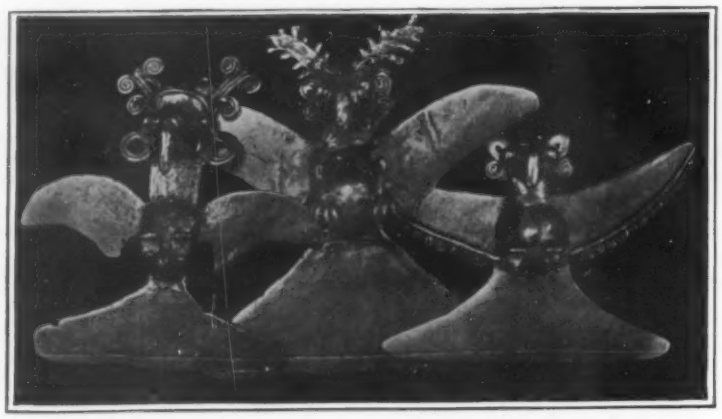
ONE of the largest and finest displays of ancient gold ornaments from Costa Rica ever seen in this country is now being exhibited at the Museum of Natural History in New York city. This wonderful collection, considered unrivaled in beauty and archæological value, is from the finds of Minor C. Keith, who has long been a resident of Costa Rica. It has been deposited in the Mexican Hall of the Museum for an extended period of time by its owner.

Splendid specimens of handiwork in metal that comprise the collection were the buried treasures of the royal rulers of the ancient civilization that flourished before the conquest of the New World in the region now embraced by the Isthmus of Panama. The fortunate incident that resulted in the first discovery of gold objects is at once unique and interesting.

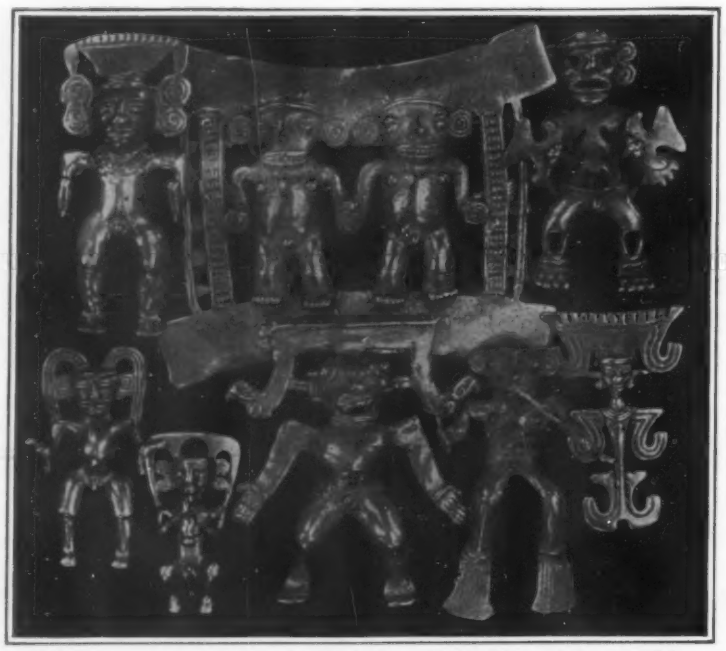
At Mercedes, in northern Costa Rica, there is at the present time an extensive banana plantation. Formerly, the site was occupied by a dense forest or tropical jungle. Mr. Keith states that one night a storm swept over Mercedes and among other things upturned a large tree. The next day while passing the tree he caught the glitter of gold in the earth that still clung to the upturned roots. Examination immediately disclosed 30 pieces of ancient gold handiwork. Evidently the tree had grown over the grave of some forgotten chief and its roots in time enmeshed the funeral offerings.

Believing that other similar treasures remained beneath the soil, Mr. Keith was prompted to undertake a series of extensive excavations not only at Mercedes but also in other parts of Costa Rica. This resulted in the unearthing of some 15,000 archæological objects in gold, stone and pottery, 7,000 of which are now on exhibition in the Museum of Natural History of New York. Needless to state, the most attractive of the objects are the magnificent series of gold ornaments; these valuable adornments being arranged in specially constructed cases and protected by a network of formidable steel.

The most remarkable and elaborate examples of the gold ornaments are represented in the accompanying illustrations. The descriptive text embodied in the article has been prepared from notes which Mr. Herbert J. Spinden, Assistant Curator of the Department of Anthropology, New York Museum of Natural History, has been so kind in furnishing to the author. It might be added that Mr. Spinden is an authority on Central American Archæology and has made a critical study of the collection.



Neck ornaments in the form of birds of prey with spread wings and tail



Gold ornaments representing human beings, singly and in pairs, engaged in various activities

The greater proportion of the gold objects appear to have been worn as ornaments before being buried with their owners. In these gold objects the characteristic animal life of Costa Rica is represented, and there are also in evidence many figures with a mythological or religious significance.

Many of the ornaments, including the disk-shaped gorgets, are made of beaten gold, with the designs in repoussé, while others are castings. Of the latter, some examples appear to have been cast in one piece and others in several pieces which were afterward welded together. The patterns were made of resin or wax and enclosed in clay, followed by the melting and pouring out of the resin or wax so as to leave the mold ready for the molten metal. Hollow castings, on the other hand, were made by building the patterns over a core of clay held in position by sprues or pins. In a number of specimens a portion of the clay core can still be seen.

After the rough castings were secured by the methods mentioned, they were finished off by hammering and burnishing.

Two kinds of gold plating were at the command of the ancient metal workers: one, a heavy plating made over copper; the other, a very thin and somewhat impermanent gilding. It has been suggested that the molds were perhaps lined with gold leaf or sprinkled with gold dust before the copper was poured in. The metal of some of the ornaments varies from pure gold to pure copper with all the intermediate alloys. In addition to copper, silver and even platinum are found in the ornaments as natural alloys of the gold.

The gold, used in such lavish quantities by the metal workers, was obtained from

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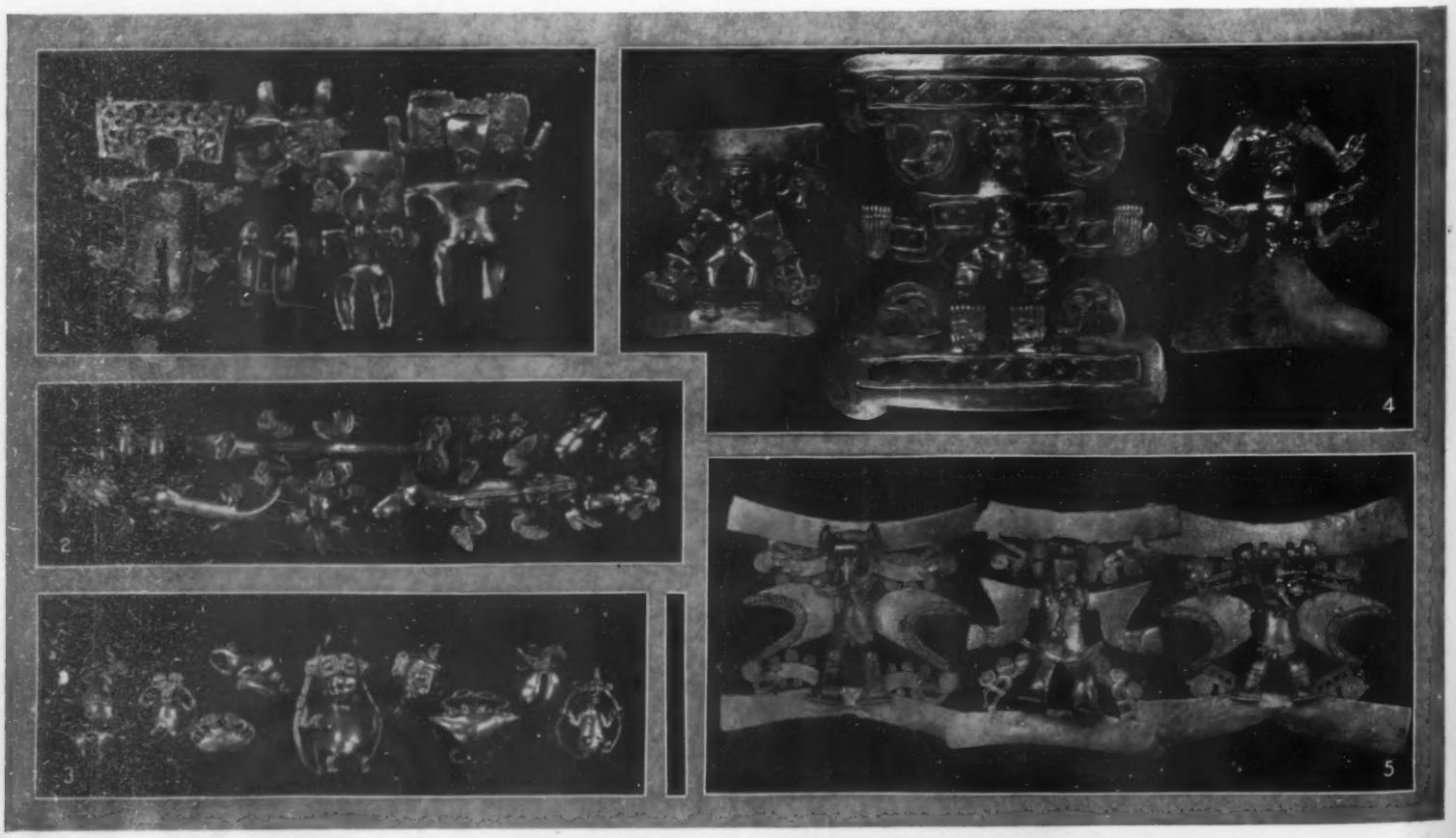
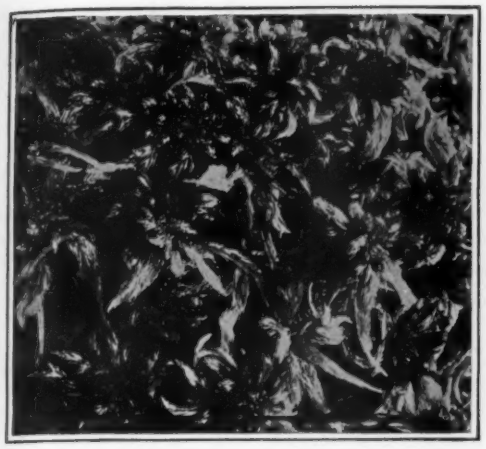


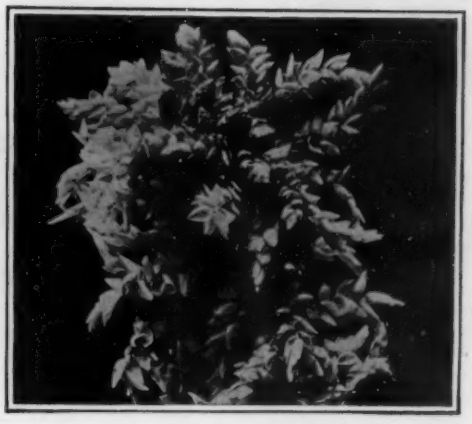
Collection of gold ornaments made by the skilled metal workers of ancient Costa Rica

The views appearing above are as follows: 1.—Gold specimens representing the ancient processes of hollow casting and hammering; 2.—Gold amulets or brooches representing frogs and lizards; 3.—Ancient Costa Rican gold bells, made to represent the heads of animals, birds, monkeys and crabs, and used as money among the people of that period; 4.—Elaborate specimens of gold amulets, made to represent gods in



Sphagnum as seen growing

Heap of the freshly gathered moss



A bit of the moss enlarged

Bog Moss for Surgical Dressings

A Substitute for Prepared Cotton Wool Discovered in England and Scotland

By Charles M. Maigne

DUE to the great European war and paralleling the development of synthetic substitutes to meet the lack of articles previously obtainable, the shortage of prepared cotton wool for surgical uses has been overcome by the utilization of certain forms of *sphagnacew*, the peat moss so common to the bogs of England and Scotland. Its recent use strengthens the claim advanced by many scientists that somewhere Dame Nature has provided for every want of mankind.

From a surgical standpoint, it is said that in many ways the sphagnum moss is superior to other dressings. Its structure is such that it has an enormous capacity for the absorption of moisture, such as wound-seepage, for the cellular processes quickly lead such extraneous acquisitions from the direct point of absorption and distribute them throughout the extent of the pad or compress made of the moss. This is highly desirable, for with the cotton wool, liquids quickly work through to bandages, clothing or bedding, to their detriment.

Sphagnum is much more springy than cotton wool and its touch upon the bare skin is grateful to patients unfortunate enough to require a surgical dressing of any description.

These springy qualities are particularly beneficial beneath bandages, for the material does not mat under the necessary compression applied and the interstices permit a wholesome circulation of air due to its structure, a condition considered as highly favoring antisepsis.

The absorbing power of the moss is remarkable, being without undue preparation approximately seven times its own weight in water. When sphagnum has undergone the complete process necessary to its use surgically, absorptive power appears greater for, as shown in the accompanying comparative illustrations, the weight of 12 ounces of the fresh moss after being dried, sorted, sterilized and dried again, was reduced to a trifle under one ounce.

With the economic problems existing under the necessity for enormous expenditures to meet the demands of the military service, the general use of sphagnum commends itself to those in disbursing authority as well as to the medical corps. It has been estimated that, were cotton wool used exclusively in the hospital service, the cost would be not less than $200,000 per annum throughout the war to Great Britain alone, while the cost of the moss is practically negligible.

As sphagnum is generally plentiful and accessible, comparatively few people are required for its collection and preparation. Committees of volunteer workers have been accorded authority by the Deputy Surveyor in the New Forest section of Great Britain to collect the moss for hospital use. While the dressing has not yet come into exclusive use it is expected that enormously greater quantities will be sent to the various lines of hospital service within a short time, than have been used hitherto.

The moss grows in tufts and large masses in and about bogs, whence it is pulled by hand. It is then dried upon netting in the open air so as to get as free a circulation as possible around it. After the first drying, it is carefully picked over so that all bits of foreign matter, such as grass, heather, leaves and twigs, may be removed.

Following its cleaning, the moss is sterilized. After a final drying it is then packed in muslin bags of convenient size for shipment in case lots.

According to the report of the American consul at Bradford, England, many cases of these dressings have so far been used in hospitals at Boulogne and elsewhere in France, and by French and Belgian hospitals in addition to its use in the British service. In other theaters of war, sphagnum has been used at Malta, Alexandria, Gallipoli and in Serbia.

Twelve ounces of the moss charged with water as gathered

The same quantity of moss after half a pint of water has been squeezed from it and the moss subsequently dried. Weight 1 oz.

In the United States, sphagnum has for some time been in common use by florists and horticulturists as a resilient medium for the packing of plants and trees. In addition, it has been used instead of earth for growing certain plants. A number of varieties of orchids, according to the observation of an eminent botanist, flourish as well in sphagnum as in their normal, cool haunts in native forest depths.

Its use by florists, however, now seems to be decreasing. Formerly the moisture-retaining property of sphagnum was valuable in the making up of floral baskets. The custom of lining flower-baskets with zinc water-containers is now so general that the utilization of the moss is practically restricted to forming the bases of floral emblems.

New Siberian Railroad is Completed

ONE of the latest additions to the Russian railways, the Altai railway, has been completed and will shortly be opened to traffic. The new line will connect Novonikolaievsk on the trans-Siberian railroad with Semipalatinsk in the Steppes Provinces. It will pass through Barnaul, in the Tomsk Government of Siberia, which will be the headquarters. The railroad is 500 miles long and will serve the richest agricultural and mineral regions of Siberia. In the Altai region there are valuable deposits of gold, silver, lead, zinc and copper which were worked in the eighteenth and nineteenth centuries but were subsequently abandoned, owing to lack of transportation facilities among other causes. The region also contains the exceedingly rich Kuznetz coal basin, 6,000 miles in extent.

Correction

UNDER the caption "Death of Theodore Berliner," there appeared an obituary notice in the SCIENTIFIC AMERICAN for November 27th, in which the deceased German electrician was credited erroneously with the invention of the loose-contact microphone, as well as the lateral-cut phonograph record. Owing to the importance which the dispatch from Berlin attached to the death of Theodore Berliner, his name was confused with that of Emile Berliner of the United States, whose contributions in the fields of electricity and acoustics have aided in no little degree towards the realization of the present-day telephone systems and disk records. The deceased Theodore Berliner was a skilled electrician and manufacturer of local fame only.

New Motors for Paris Pumping Station

THE difficulty in building alternating current motors with commutator is not to be counted by the absolute power of the machine in question, but by the power in relation to the number of poles of the motor. It is a fact that if we consent to lower the speed and increase the number of poles and sets of brushes, it is possible to build motors of very high powers. It is thus an advantage to design a motor having a high power per pole and with few brush sets, also using a reduced width of commutator. As the difficulty of design increases with the frequency of the current, a motor using 40 or 50 frequency is especially interesting. Two of the Paris water pumping plants are commencing to use new motors of this class, made at the French Teumont works. At the Austerlitz plant in town there were put in six three-phase motors with commutator, such motors having the shaft mounted vertical. Each gives 500 horse-power and operates at 700 revolutions per minute. Here the power per pair of poles is 100 horse-power, and there are only 12 sets of brushes used. At the Montsouris city plant, there is installed a single-phase motor of 200 horse-power and 42 frequency, of another design.

Hawaiian Blowholes

By Vaughan MacCaughey

WELL-KNOWN to everyone who has either traveled widely or read widely of travel-books is the fact that every country that skirts the sea has its own distinctive type of coast line. How familiar are the mental pictures flashed up by such phrases as: fiords of Norway, chalk cliffs of England, sands of Morocco, barren coasts of Chili! With the palmy isles of the tropical Pacific is associated in the popular mind a vision of shining coral strands. It is true that a very large number of the Pacific islands have extensive and characteristic beaches—indeed the atolls and low islands have no others—it is also true that many of the high or volcanic islands have rugged, rocky, precipitous shores, against whose menacing battlements eternally pounds a tireless surf, causing constant erosion.

In Hawaii the coasts of this latter type are invariably built up of ancient lava flows, which have run down to the sea from the mountainous interior. These old lava streams are penetrated by serpentine caverns, large and small, which were produced by the molten lava flowing out from under its own hardened crust and thus forming a long sinuous tube. Some of these tubes extend for miles back into the heart of the mountains, others are mere fissures. In addition to the tubes there are also many interstices between the beds themselves, owing to the fact that a fresh lava flow does not fit absolutely snugly onto the old flow over which it has spread. The unconformities result in pockets and caverns of various sizes.

Along the coast line, where the heavy Pacific swell is continually battering, the sea finds its way back into such of these tubes and caverns as chance to be at its level. With boulders and coarse lava gravel as its teeth, and the tremendous swing of the surf as its motive power, the sea gradually excavates and enlarges these basaltic tunnels. In this way sea caves, large and small, have come to be a notable feature of Hawaii's rocky shores.

Occasionally, in those smaller caves which have over them but a relatively thin crust of rock, portions of the ceiling or roof are undermined and fall in, producing a vertical shaft or outlet at the end of a horizontal water-filled tunnel. The result of this fortuitous combination of sea, cave, and air shaft is unique and picturesque. With every beat of the surf against the rocky shore the sea rushes noisily back through the cave, the air is temporarily compressed, and escapes with a loud soughing or hissing through the narrow vent above, and suddenly a great geyser-like column of foam and water shoots up through the orifice, sometimes attaining a height of 50 or 75 feet. These are the famous Hawaiian blowholes, which are so characteristic of these islands.

Several years ago a party of men, of which I was a member, was engaged in a pedestrian tour of the island of Oahu. We camped for several days on a beautiful coral beach near Koko Crater, an ancient volcanic vent. At one point along this beach an old lava bed had run out over the coral, forming a black and jagged blot upon the smooth white beach line. The sea had undermined this flow and formed several fine blowholes. One had a funnel-shaped aperture of some 12 inches, and intermittently discharged magnificent columns of spray and water. We quickly discovered the unique bathing facilities thus made available to us. Morning and evening we would all strip, walk over to the blowhole, and stand close by the vent. At every eruption we were drenched by the deliciously cool salt water from this bizarre "upside down shower bath!" The first sensations were those of the air-charged spray rushing up from below; it was like receiving the discharge from an enormous soda water bottle. This was breathlessly succeeded by the sudden precipitation of the water, in huge sparkling globes, from the height of some 40 or 50 feet. All this to a weird accompaniment of hisses and soughs, and the swish and gurgle of hidden waters.

Rear view of a blowhole in action. The spray column is sixty feet high. The true vent is concealed in a funnel-like depression in the lava flow

A Hawaiian blowhole in full action. The spray column is about thirty feet high and across it play the delicate tints of the rainbow, sometimes forming a broad band of exquisite hues and textures. The rock is an old lava bed

The brilliant sunlight upon these spray columns robes them with scintillating and dazzling beauty. The impact of the sea and the sudden expansion of the compressed air shiver the water into the finest spray, whose minute droplets are transfigured by the sunlight into a myriad iridescent ephemeral jewels. Across the spray column play the delicate tints of the rainbow, sometimes forming a broad band of exquisite hues and textures.

The noisiest blowhole that I know of in Hawaii is at Maka-puu Point, a rocky headland of Oahu. It is several hundred feet inshore, and penetrates a thick lava sheet. The distance from the submarine cave below to the upper opening of the vent must be some 15 or 20 feet. The vertical shaft is so tortuous that when looking into it one can perceive nothing save its smooth rock walls. The vent itself is about 8 inches wide, and from it issues a continuous moaning and savage sobbing. The hoarse shriek rises as the sea rushes in, and subsides as the sea retreats and sucks the air in after it; very much as one may whistle either by expelling or inhaling the air through the contracted lips. At high tide the spray column of this blowhole simulates a magnificent geyser.

These picturesque "spouting horns," as they are sometimes called, occur at various places along the island coasts. The horizontal caves vary in length from thirty to several hundred feet; the vents vary in width from a few inches to 4 or 5 feet. Some are famous in the ancient chants of the primitive Hawaiians; others are mentioned with wonderment by the seamen who first skirted the shores of this remote island world; all will long attract the interest of those travelers who are fortunate enough to roam Hawaii's picturesque beaches.

Recent Completion of the Kensico Reservoir

NO more convincing proof of the unprecedented progress made in masonry-laying during recent years could be found than that offered by the Kensico reservoir dam, which is part of the Catskill water supply system of New York City. Although the date originally set in the contract called for the completion of the work on February 14th, 1920, the dam has now been completed to a stage the contract date of which is April, 1919. Water has recently been admitted into the reservoir—an event which is nearly four years earlier than was expected when the contract was prepared.

The Kensico reservoir is east of the Hudson River and thirty miles from City Hall, New York City. It will contain eventually several months' supply of Catskill water and will act as a storage reservoir, so that the flow into the city will not be interrupted while the 75 miles of aqueduct between it and the Ashokan reservoir is being inspected, cleaned or repaired at any time. It will also be the great wholesale distributing reservoir for the metropolitan district.

Briefly, the reservoir is formed by the Kensico dam, which stretches across the valley of the Bronx River, about three miles north of White Plains. One mile northwest from the Kensico dam a low gap in the hills was filled with an earth dike about 1,450 feet long, with a maximum height of 25 feet. The water will be about 110 feet deep over the surface of the old Kensico reservoir, which was developed in 1885, and will be 54 feet deep over the surface of the Rye ponds, which were auxiliary to the old Kensico reservoir and are included in the new.

For the purpose of the new Kensico reservoir 3,200 acres of land were acquired, which, in addition to the 1,300 acres acquired for the old reservoir and Rye ponds, make a total of 4,500 acres. In this total there is included a marginal protective strip around the entire flow line, in but few places less than 500 feet.

Catskill water will be delivered into the Kensico reservoir at the upper end of the Bronx valley, where there is a covered influent weir and a gate house. The water will be drawn from the reservoir through a short tunnel at a point on the west side of the reservoir, about one mile above the Kensico dam. At the reservoir end of this tunnel is the upper effluent gate house, containing sluice gates for controlling the flow from the reservoir into the aqueduct. At the lower end of the outlet tunnel is a large gate chamber, in which the flow of the water will be regulated by valves and either diverted through the Kensico aerator or sent directly to the aqueduct. Near the lower gate house is the screen chamber, in which all the water will be passed through fine-mesh screens before it flows on toward the Hill View reservoir, 15 miles to the south. A reinforced concrete by-pass conduit, 11 feet in diameter and 11,000 feet long, joins the influent gate house and the upper effluent gate house together, so that water may be delivered directly to New York at any time without entering the reservoir.

The Kensico dam is a gravity masonry structure of cyclopean concrete. The upstream face is of concrete blocks. On the other hand, the downstream face below

(Concluded on page 526)

The works at the upper end of Kensico reservoir

Admitting Catskill water into the Kensico reservoir

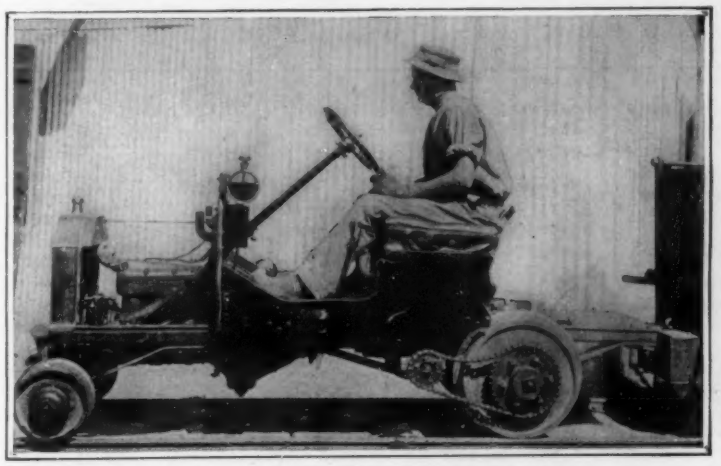
Converted Automobile as Motive Power for Mine Cars

USING an automobile to haul ore cars is the novel and efficient method introduced by E. M. Gleim, superintendent of a prominent and progressive mining company at Shafter, Texas.

In an effort to reduce the operating expenses of ore cars, Mr. Gleim decided to install some kind of motive power. Then the idea occurred to him of converting a cheap automobile, which he had driven some 12,000 miles, into a gasoline locomotive, equipped with steel flanges so that it could run upon the tracks leading from the mine to the mill. The drive shaft was shortened and the differential moved up close to the transmission case. The rear axle was cut off and used as a jack shaft, while keyed to its ends were two sprocket wheels driving to sprockets on the rear wheels. The ratio of these sprockets was 3 to 1, this being the only gear reduction introduced.

The weight of the full load pulled by the improvised locomotive, consisting of three two-ton side-dump ore cars, is about 16,500 pounds. The motor travels 18 miles each day with this load, and a like distance with empty cars. The consumption of gasoline is about 4½ gallons per day, while one gallon of oil is used for lubrication.

The cost of converting the automobile into a locomotive was $150.



With several minor changes, this automobile was converted into a very serviceable mining locomotive

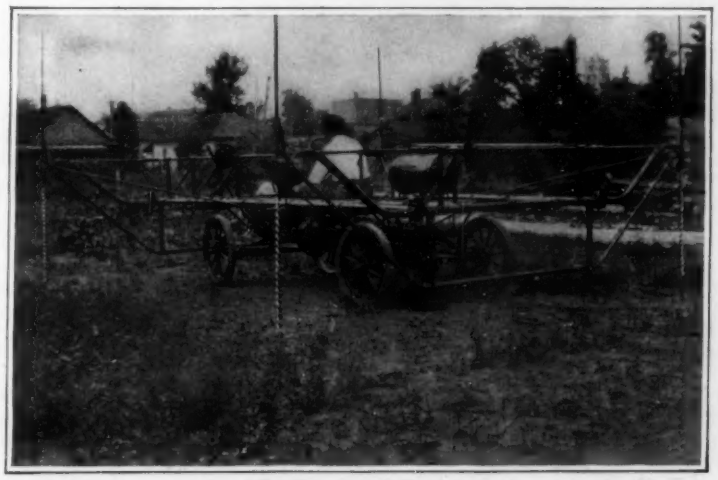
Portable Earth-Boring Machine of New Design

A MACHINE suitable for boring vertical holes in hard ground has recently been invented and patented by Mr. Andrew Flesher, of Taylorsville, Illinois, and is of especial interest because of its ingenious mechanical details.

In design, the new machine is very simple, in view of the flexibility required for the different classes of work for which it is intended. The frame consists of a set of light, tubular, hinged trusses, so designed that they may be folded for transporting or for passing through gates. These trusses have a spread of 15 feet, and at the ends are fitted with gear-driven boring heads for operating the drills or augers. Several of these trusses may be used on each machine, though it is primarily intended that two trusses operating four boring heads shall be used. The two trusses are spaced 15 feet apart, permitting the boring of four holes, 15 feet apart, at each move or set-up.

The original design of the machine mounts the equipment on an automobile chassis, although it can be mounted on a wagon or light truck. When mounted on a chassis the motive power for driving the boring heads is furnished by the automobile engine. A small, stationary gasoline engine is used for power when the chassis is replaced by a horse-drawn wagon.

The work for which the machine is designed is the boring of holes in the ground for loading charges of explosives for shattering hard soils, for blasting holes for tree planting, for blasting holes for setting telegraph and telephone poles, for blasting ditches, and for controlling the soil moisture, all of which operations demand the making of many holes in hard ground.

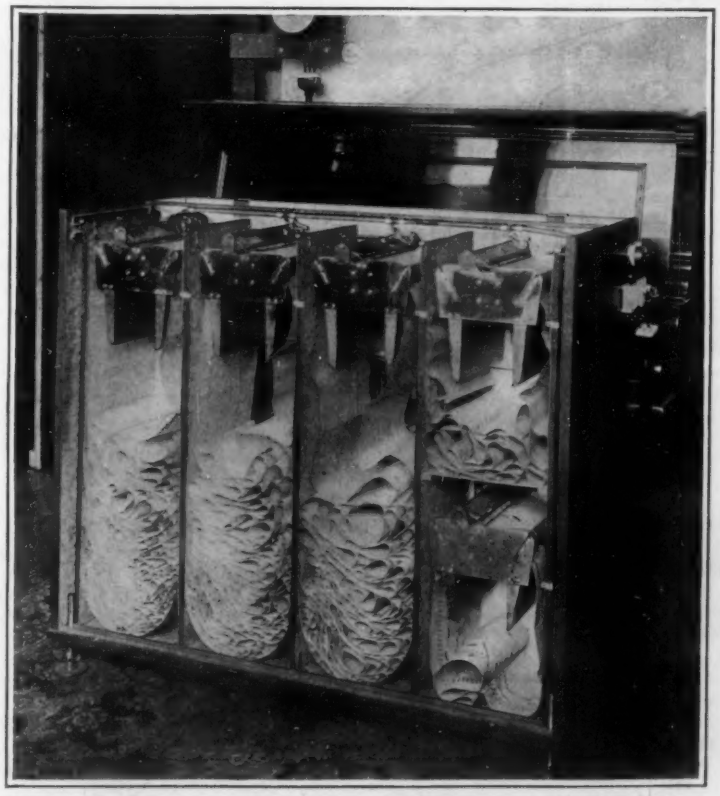


Automobile chassis fitted with framework and appliances for boring holes in the earth

Remote Controlled Electric Piano for Picture Theaters

THE contention that the ordinary automatic pianos are not suited to motion picture theaters and that the smaller houses can ill afford to hire proficient pianists—poor pianists being considered worse than none—has resulted in the introduction of an electric piano-player that is controlled by push buttons located in the operating booth. It is possible for the picture machine operator to immediately alter the music of the piano to conform with the ever-changing action on the screen.

The electric piano-player may be placed in front of any piano; the latter being located in front of the screen or in any other part of the picture theater. In the operating booth are several push buttons that control the mechanism of the piano-player. The operator, following the action of the picture on the screen, has the musical program constantly under his control. As the scenes vary, he can change instantly from one selection to another, even to the breaking off of playing one selection at any note and starting another tempo the next second. The extreme flexibility of the control permits of absolute consistency between music and film action at all times, it is claimed by the inventor.



Mechanism of the electric piano-player, showing the endless perforated records and contact pin holders

Briefly, the mechanism of the electric piano-player consists of several endless perforated rolls which serve to make and break the circuits of the key-actuating mechanism through a series of electrical contact pins. Any one of the several perforated rolls may be played by pressing the corresponding push buttons in the operating booth. The musical program embraces: crescendo or thunderous music for battle scenes and the like; allegretto or fast, lively music to accompany highly animated scenes, such as horse or automobile racing, or even chases; moderato for social or dramatic scenes; diminuendo or slow music to accompany pathetic or sentimental scenes; Indian music to convey realism to American Indian scenes, and staccato chords for highwaymen or burglar action. Automatic expression is a feature of the records.

In addition to the various kinds of music to accompany screen action, it is possible to equip the electric piano-player to emit different noises, such as battle chaos, shooting, thunder and wind, which at the present time are produced by the pianist with the aid of numerous odds and ends.

Effect of Tobacco on the Heart

FRENCH scientists find that tobacco, even when denicotinized, has a marked and deleterious effect upon the heart. For some time past, such effect was noticed upon the large blood vessels such as the aorta, but the present researches concern the heart proper, and it also appears that the action is not, as might be supposed, due to the nicotine proper, for smoke from other sources appears to have the same bad effect, and even in tobacco this does not depend on the proportion of nicotine. The present work was carried out at the physiological laboratories of the Paris Medical College and the results presented before the Biological Society. A graphic method was employed to observe the contractions of the heart, and the isolated organ was acted upon by the smoke of different brands of tobacco, such smoke being dissolved in Ringer's solution, such as is used by Carrel and others for preservation of tissues. As this liquid is not toxic, it does not affect the results. It is found that using the smoke solution, the heart beats grow less and less, then the heart stops, unless it is restored by pure Ringer's solution. It is then asked what part the nicotine plays in this action, and, using high grade French tobacco with 3½ to 4 per cent nicotine and also low grade at an average of 1.35 per cent, it is seen that the latter is far from proving as inoffensive as was thought. Although the details of the phenomenon differ, the result is that even with the weak tobacco the action of the heart is paralyzed after a certain time. Such action is therefore not exclusively due to nicotine, or even in fact exclusively to tobacco, for tests made with oak leaves, for instance, showed that it is to be ascribed to the multiple products of combustion which are contained in smoke of widely different origin.

Radium Fertilizer Too Costly

THE effect of radium salts on field crops has been thoroughly tested by Hopkins and Sachs, of the University of Illinois, using quantities up to one milligram per acre. They found no appreciable benefit with such quantities.

Since radium is found in traces in all substances, it has been calculated that in an acre of soil 5 inches deep there is only about one milligram of radium, so Hopkins and Sachs paid $100 to double the quantity of radium already in the soil—and without results. A radium fertilizer is sold by a company recommending one pound to 50 square feet of soil. R. R. Ramsey estimates that this adds to the soil only one tenth the amount already there—an evident waste of good money.

It is also known that radium emanation, a gas given off by radium, is constantly rising through the soil from the depths of the earth and this amounts to one hundred times the emanation given off by the upper 5-inch layer of soil. Hence, to double the amount of radium emanation available for crops the farmer must sow seventy-five milligrams of radium to an acre at the trifling price of $7,500. It is evident that even the most modern farmer will remain satisfied with such stock of radium as is now locked up in his farm.

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

Process for Producing Colored Photographic Prints

OVERCOMING several of the objections that have heretofore limited the numerous processes of producing photographs in natural colors, there has recently been demonstrated a new method that marks a distinct step towards the popularization of this most important form of photography.

The new process represents the efforts of Frederick E. Ives, who has devoted a number of years to the subject. Instead of producing the usual transparencies which must be viewed with a light shining through them, as when hanging in a window or used as lantern slides, the Ives method makes possible photographic prints in colors. Any desirable number of prints can be made with the same set of negatives. Furthermore, the simplicity of the process brings it within the reach of the amateur photographer.

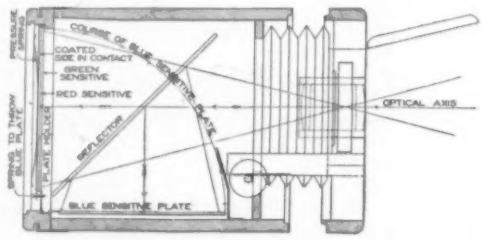
The Ives process makes use of a special camera of the simple, box type, permitting the exposure of three sensitive plates at the same time. The basis of the system is to secure the same view on the three plates, but the rays of light striking each plate are filtered through a screen of different color. These screens represent the three primary colors—red, yellow and blue. In appearance the three negatives thus secured vary but slightly as to their density, each one having registered the relative value of the color it represents as reflected by the subject photographed.

The manner in which the new camera exposes the three plates to the light from the lens is highly ingenious. The three sensitive plates are arranged for commercial use in a metal carrier, similar to the ordinary film pack. The carrier is hinged at the bottom, and when it is to be used it is placed in a holder similar to that employed to hold film packs. When placed in the camera and the slide withdrawn, the front of the carrier falls to the bottom of the camera, carrying with it the front one of the three plates. The two remaining plates remain upright in the back of the camera with their sensitized surfaces together. At this point the movement of a handle at the side of the camera brings into position an amber tinted glass which is held at an angle of 45 deg., as shown in the accompanying line drawing. The inclined sheet of glass serves a dual purpose: it reflects a portion of the rays passing through the lens at the time of the exposure, down onto the plate resting on the bottom of the camera; and it acts as a color filter to the rays passing through it to the plates in the rear. The last-mentioned rays strike the first of the two plates without hindrance, but before reaching the second plate they are further filtered by a coating on the sensitive emulsion of the forward plate.

Thus each plate has been suitably screened at the time of exposure and all have been exposed at the same instant. By a mechanical movement controlled by the lever at the side of the camera, the blue plate is brought back to its original position in the holder so that the slide may be replaced and the holder removed.

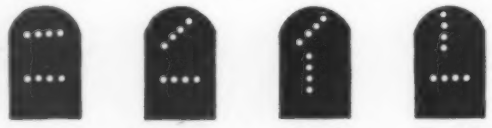
Development of the three plates is essentially the same as in ordinary black-and-white photography, except that it must be done in the dark since the plates are sensitive to all colors. For this purpose there is employed a special developing tank that accommodates the carrier with the three plates separated so that all are subjected equally to the action of the developing solution. The developing proceeds by what is known as tank development; a weakened solution being used which brings out all the detail, although somewhat prolonged. Since the developing of the plates is automatic, the photographer may leave them in the tank while attending to other matters, until the 30-minute period required has expired. Fixing, washing and drying follow, after which the negatives are ready for making the colored prints.

Placed side by side in a printing frame, the negatives are underlaid, one with a paper that makes a print in blue tones and the other two with a transparent film coated with bichromate of potash; the latter being the most sensitive substance known in photography, outside of the nitrate of silver ordinarily used in the manufacture of plates and films. It differs from the nitrate of silver emulsions in that it makes an image in slight relief. The two films, after being developed in hot water, are baked in hypo in order to discharge the silver salts, followed by immersion in a bath of dye corresponding in color to that of the screen through which their respective negatives were made. The two films thus secured are then superposed over the blue print and so registered that all the outlines coincide, whereupon the eye, looking through the two films at the blue print, sees the original subject reproduced with absolute fidelity in all its colors. It is stated that the sheen of the satin dress, the soft and colorful shadows of filmy drapery, and the cobwebby bloom of the grape are all recorded faithfully by the camera and imparted to the prints.

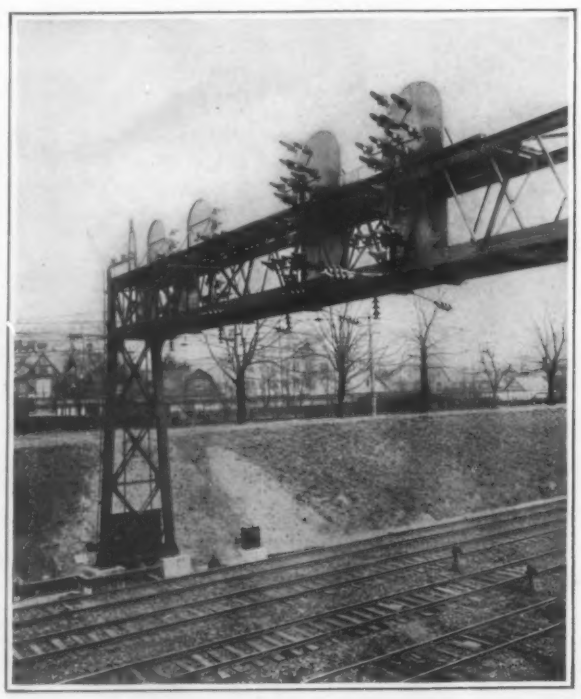


Sectional view through color camera at instant exposure is made

Hand camera for the simultaneous exposure of three color-differentiating negatives



Indications by the position signals



Signal bridge on the Pennsylvania road carrying the new position light signals for both day and night operation

Clearing House for Naval Inventions

IN furtherance of the plans to utilize the inventive genius of the Nation, the Secretary of the Navy has appointed an engineering officer to a post which the Secretary describes as a clearing house for suggestions. The naval officer will consider all communications dealing with proposed new devices for Navy use, sift out the useless ones and refer the remainder to the particular bureau to which they pertain. He will be attached to the bureaus of construction and repair, of steam engineering and of ordnance and will assist in studying the mass of suggestions with which the Navy Department has been flooded since the outbreak of the European war.

A thousand such suggestions have been studied by the bureaus during the last year, the work impeding them in their regular duties. From the grist of suggestions ground through the departmental mill will be selected those of most promise, to be taken up in order of importance with the civilian advisory board recently created, with Thomas A. Edison as chairman. Where the germ of a real idea is disclosed the bureaus and the board will coöperate in an effort to give it practical value to the Navy.

In addition to this the board will initiate suggestions of its own to better the mechanical equipment of Navy ships.

An Innovation in Railway Signaling

WHEN the electrification of the section of the Pennsylvania Railroad between the Broad Street Station and Paoli was undertaken it was found that, owing to structural reasons, most of the signals would have to be replaced, and in the new installation it was decided to try out an entirely new and decidedly novel system. The new signal consists of several series of electric lights, which show sharply against a dark background, and are so arranged that by lighting the proper row any position of a semaphore can be reproduced, either horizontal, diagonal or vertical, and each signal has a sufficient number of lights to be equivalent to two semaphore arms.

These lights are all white, and consequently color has no part in the meaning of the indications given by the signals. Another novel feature is that these lights are used for signaling both night and day, the only difference being that a stronger current is used during the day. With the dark background it has been found that these light signals are distinctly visible at a distance of more than 4,000 yards even in the brightest sunshine.

It will be appreciated that this system of lights entirely does away with the usual semaphore arm, with its many moving parts to get out of order, and its double system of indication by position by day and colors by night, and that the enginemen have the same kind of signal every hour of the twenty-four. These signals are mounted on steel bridges above the tracks, and each one protects 3,500 feet of track. A train passing a signal automatically sets it at "Stop." The "Stop" signal is a warning that there is a train somewhere in the block beyond the signal.

When the first train passes out of the block, the signal at the entrance to the block automatically changes to "Caution." The "Caution" signal always means one block ahead is clear, but the next one is occupied. A third position of the signal lights shows when two full blocks ahead are clear, and a fourth position when three or more blocks are unoccupied.

Under this arrangement, a motorman always receives notice of a possible "Stop" at least 7,000 feet in advance, and always receives at least two cautionary signals before approaching a "Stop" or danger signal.

This system has proved very satisfactory, and will probably be extended as occasion requires.

Chairmen of Congressional Patent Committee

IN the present Congress, Chairman Oldfield will go on the important Ways and Means Committee, the work on which committee is such that he will be relieved of other committee duty, so we will have another for chairman of the House Committee on Patents in the next session. It may be of interest to consider the patent chairmen in both houses of late years, noting especially the geographical distribution as appears from the following statement covering the period from 1887 to 1915. The fol-

lowing statement shows the various chairmen beginning with the 50th Congress to and including the 63d Congress:

United States Senate: Hon. Henry M. Teller of Colo., 50th and 51st Congress; Hon. Nathan F. Nixon of R. I., 52d Congress; Hon. George Gray of Del., 1st and 2d Sess. 53d Congress; Hon. Wilkinson Call of Florida, 3d Sess. 53d Congress; Hon. O. H. Platt of Conn., 54th and 55th Congress; Hon. Jeter C. Pritchard of N. C., 56th and 57th Congress; Hon. Alfred B. Kittredge of Nebr., 58th and 59th Congress; Hon. Reed Smoot of Utah, 60th Congress; Hon. Norris Brown of Nebr., 61st and 62d Congress; Hon. Ollie M. James of Ky., 63d Congress.

House of Representatives: Hon. John B. Weaver of Iowa, 50th Congress; Hon. Ben Butterworth of Ohio, 51st Congress; Hon. Geo. D. Tillman of S. C., 52d Congress; Hon. James W. Covert of N. Y., 53d Congress; Hon. Wm. F. Draper of Mass., 54th Congress; Hon. Josiah D. Hicks of Pa., 55th Congress; Hon. Winfield S. Kerr of Ohio, 56th Congress; Hon. Walter Reeves of Iowa, 57th Congress; Hon. Wm. W. Skiles of Ohio, 1st Sess. 58th Congress; Hon. Frank D. Curried of N. H., 2d and 3d Sess. 58th, 59th, 60th and 61st Congress; Hon. Wm. A. Oldfield of Ark., 62d and 63d Congress.

In the Senate, New England has had only two chairmen, Nixon of Rhode Island and Platt of Connecticut, out of ten, while the West had four, and in the House, New England had only two out of eleven, the West five, and the South two.

Relics of Ancient Costa Rica

(*Concluded from page 520*)

placer deposits that sometimes yielded nuggets of fair size. Bronze, apparently, was not made.

Human beings, as will be seen in the accompanying illustrations, are represented with peculiar headdresses and with various objects carried in the hands. Sometimes they are joined in pairs. Many of the most beautiful amulets are frogs arranged either singly or in groups of two or three. These little figures are all provided with a ring for suspension purposes, on the under side. Lizards, turtles and crocodiles or alligators are also represented in the amulets.

Not a few of the golden ornaments represent gods in human, animal and bird form, decorated with the heads of crocodiles, particularly the more elaborate specimens. The crocodile, especially, appears to have been deified and in great favor. It is often represented with a human body and the characteristic head.

In the ancient pieces of gold craft the close relations existing between man and the animal life that surrounded him are vividly brought out. The animals that were powerful or possessed some special efficiency were transformed into gods. Several of the finest specimens of gold work in the collection are those which show some of the highly conventionalized figures of gods. One series of such figures has canopies made of rectangular gold plates held by standards. Others show the animal-god in question performing some act. Examples of this are two bird divinities, one with a lizard and the other with a flying fish held in the mouth. In both instances the headdresses of these deified birds are elaborated with the profile head of the crocodile. In still another instance a bird is shown with a fish in its mouth, while four fish are attached to its head and legs.

Gold and copper bells served as money among the peoples of Mexico and Central America before the time of the American Indian: these being all of the hawk's bell type. The gold bells of Costa Rica are exquisite examples of metal work. Many of them are modeled in the form of birds, monkeys and grotesque heads.

It is only in a very small percentage of graves that gold has been found, and in all probabilities from the graves of the chiefs solely. Pottery and stone carvings are found in most of the burials, but rarely in the ones that contain gold. The graves are in the form of small chambers lined with river boulders or with slabs of stone. Bones are seldom found in them, but this fact may be accounted for by the

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climate which hastens decay, rather than as an indication of great age.

It is most unfortunate that a systematic rifling of ancient cemeteries by treasure hunters has been going on since the coming of the Spaniards; more so indeed when the facts disclose that most of their finds have gone into the melting pot, thus resulting in the loss of much of the ancient metal workers' art which represents innumerably greater value in its ornamental form than the gold which it contains. This renders the Keith collection of greatest interest because of the rareness of the specimens, as well as for the reason that it presents the technical processes of the ancient goldsmiths, such as hammering, engraving and hollow casting. There is but little doubt that the makers of these ornaments were the ancestors of the Indian tribes that now inhabit the region the name of which, Costa Rica, "rich coast," was suggested by the large quantities of gold obtained from the natives.

How a Rifle is Sighted

(*Concluded from page 516*)

All other rifles of military type use open sights well up the barrel, the notches cut either U or V in shape, usually the latter. Just as the peep sight is more efficient when close to the eye, the open is cut clearer when set a distance away, being then nearer to the focal plane of the front sight and the mark. Although the open military sight is seen more clearly when it is set a good distance from the eye, it cannot go too far away because then the distance between the sights is cut down, and errors are increased in the same proportion, on the target.

The German Mauser sight is known as a ramp sight. It is a leaf hinged at the forward end, and lying flat on the barrel. A ramp or inclined plate lies between the bars of the leaf, in one model. When a locking button in the sight is released by being compressed between thumb and finger and is pushed forward up the ramp, it carries the sight leaf upward, giving elevation for the various ranges, which are marked on the side of the ramp. The sight locks itself when the button is released.

The British sight, aside from being the old crude open type, is the best of all the fighting rifles. The open feature could be altered at small trouble, and a peep provided.

Pushing the elevating bar forward up an incline gives elevation, the ranges being marked on the leaf of the sight that normally lies flat on the barrel. A wind gage is provided, and by means of a fine worm screw, the fine changes necessary in long range target shooting can be made between the coarser yard graduations. Saving the feature of being an open sight, it is probably the most practical of all outside the Canadian back sight.

The American Springfield sight has grave errors, being neither a practical military sight nor an efficient target sight.

When the leaf is raised vertically for use, it is exposed to blows, and is more or less in the way. Standing vertically, the green soldier perceives a notch of U shape, cut in crossbar of the leaf, and good for 2,850 yards, then below that another notch cut in the slide, and below that a triangle milled out in the plate of the slide, and a third notch cut in that. Below this is a round hole, the peep sight. If the range is 500 or 600 yards, raising the slide leaves an irregular shaped hole between it and the base of the sight, through which the rookie invariably proceeds to aim. So the green man has in front of him three different notches, a peep, and possibly a hole between slide and base that looks as if it might be intended to aim through.

When the sight leaf is laid flat on the barrel, the battle sight is in view, a notch of U shape, sighted for 530 yards. This is one of the most brilliant features of the rifle, a sight carefully designed to do away with all the virtues of the flat trajectory of the very modern army rifle. Being sighted for 530 yards, the rifle shoots more than 2 feet high at 300 yards, and the soldier is told to aim that much low. Inasmuch as the soldier is not disposed to judge distance carefully in the heat of a battle, and inasmuch as a battle sight is supposed to be a sight with which you can hold on the enemy regardless of his range if he is within its scope, the American battle sight is carefully designed to put the entire sheaf of fire over the enemy at the most useful range.

What should be done, is to sight the rifle with this battle sight—an emergency sight we might call it—for 400 yards, when the bullet would rise nowhere more than 10 inches higher than the line of sights and the soldier could then hold on his foeman at any range up to the 400-yard limit of this sight. This is utilizing the flat shooting of the rifle as it was intended to be utilized—that is, letting the very flat flight of the bullet, take care of all errors in range estimate and so make range estimate unnecessary up to the limit of the battle sight. To hold high or low for various distances is to get back into the class of the most old fashioned, slow speed, high trajectory rifles, where one had to hold high or low or change sight setting to compensate for the fall of the bullet.

A flat trajectory modern rifle means that the bullet flies nearly as level as a stretched string for a certain distance, because of its high speed, and so long as this rise and fall of the bullet in getting over a certain range does not become enough to miss a prone man, then that range is the battle range, and the sight should be adjusted to shoot to center over it. Then if a man is nearer, the bullet still does not get high enough to miss him, and the soldier merely holds on his mark at any range within this limit.

When, because of its high speed, the bullet from the German Mauser does not have to rise higher than 20 inches to hit the center at 500 yards, then the battle range and the battle sight of that rifle is nearly 500 yards long. Up to that distance the sight setting does not have to be changed, the 500 yard setting catches nearly anything in between.

And, as pointed out, the most practical form of such a battle sight, would be a large peep, set on the receiver bridge of the rifle so that the soldier could merely put the front sight on the mark and fire after he had once glanced through the peep to make sure that his eye was opposite to it.

Strategic Moves of the War, December 4th, 1915

(*Concluded from page 518*)

new forces were raised. To equip them, Japan, England and France organized to get material into Russia via Vladivostock and Archangel. Railway lines were built and dispositions were made to handle the imports, with the result that an almost ample supply has been introduced into Russia, according to reports.

The time arrived when Germany and Austria found it necessary to husband their fighting strength. It is claimed—and seemingly with logic—that practically every available man in the Central Empires is now engaged either on the actual battle line, held in armed reserve or being utilized in some interior capacity to further military operations, leaving for the replacement of losses only boys who are becoming of military age.

The war has raged for 16 months. The battle lines are so far-flung that it is estimated that the Teutonic Alliance has reached the zenith of its strength development. From now on, it is not unreasonable to assume that numerical superiority of the Entente should tell more heavily than formerly. In addition, the Entente Powers seem to have remedied the handicap of individual operation by establishment of a quasi-international general staff to direct all operations with due regard to coöperation and the ultimate objective of the war. England is just beginning to develop her full strength. France is practically unhurt in the power of her forces. Italy seems on the verge of winning an important military trick and Russia is reorganizing.

The present time, therefore, seems to be the most promising moment for Teutonia to achieve peace, as there is every indication that it is entirely possible for the war to continue indecisively for years, until the continent is desolated—and the strength of the Entente seems to be increasing. If peace should be made now, Teutonia holds the winning cards. Cast on the conference table, they represent territorial holdings of French, Belgian, Russian and Balkan soil—and vast undefeated armies, an intact navy, tremendous military prestige and a sentimental, humanitarian plea to avoid further bloodshed.

To offset these trumps, the Entente holds merely Germany's possessions beyond the sea, a tiny strip of the Lost Provinces and—forces which have not suffered decisive defeat. It seems logical, then, no possible political benefit can accrue to the Entente by the immediate establishment of peace. Should it be imposed or accepted, it would represent defeat of every principle for which the nations of the Entente appealed to arms. Germany would remain, according to her enemies' claims, a constant, unweakened military menace to the world, a huge indemnity would certainly be required for the surrender of captured territories and the burden of paying it would handicap the commercial development of the debtors until Germany was preponderant in world commerce. Her place in the sun would have been won.

A threat against Great Britain's empire can not be seriously entertained as present affairs stand. From Constantinople to the Suez canal is a about 1,200 miles, the line of communication being represented by a single railway perilously exposed to attack from the seaboard for hundreds of miles. Bearing in mind, too, the security of the pure defensive in the present day, there is a tongue of land not over 70 miles in width, covering the line of approach to the canal, which may easily be defended as the flanks of the position are secured by the Mediterranean and the Gulf of Akaba. A million men (there would be ample time to get them into position after the possible development of a serious movement) can hold it fast, definitely blocking the way to Egypt and India by that route. Teutonia will attempt no such movement. It would require millions of men to endow it with hope of success and there are no men to spare.

The main object, then, of the Serbian campaign, successful so far as it goes, may reasonably be considered as but the acquisition of another territorial trump card with which to play the game of possible peace negotiation, even more than the purely tactical one of aiding an ally and connecting the distant parts of the Alliance.

It is almost a certainty that subtle peace negotiations will be uncovered ere long. If they are declined by the Entente, there will be little lost to Teutonia, for a diplomatic shift of responsibility may then well be advanced, on the plea that the Entente is unwilling to listen to humanitarian proposals. It is a deep game.

In résumé the Central Empires hold hundreds of thousands of miles of conquered territory; their armies are intact, even though finances are ebbing and food is becoming less plentiful; military prestige has inspired a whole world by impressive Teutonic feats of arms against greater numbers. Every advantage would accrue to Germany through peace within a short time—and the war would have been won. It hardly seems probable that the Entente will consider peace at present, for the waiting game appears to be on the verge of bearing fruit.

Recent Completion of the Kensico Reservoir

(*Concluded from page 522*)

the final grading was moulded against forms, while the remainder of the face above is of cut-stone masonry. The entire dam is divided into sections by transverse expansion joints about 79 feet apart longitudinally. These expansion joints are faced on one side with concrete blocks, forming a series of vertical tongues and grooves, against which the masonry of the other side was built. Near the upstream face a copper strip has been placed

across each expansion joint, continuous from top to bottom, to act as a water stop. The contraction and expansion are caused by changes of temperature, and result in a slight opening and closing of the joints from season to season.

Drainage wells, 15 feet apart longitudinally, formed of porous concrete blocks, extend from an inspection gallery below the top of the dam near the upstream face to an inspection gallery near the level of the reservoir bottom, which in turn connects with a transverse drainage gallery leading to the downstream face of the dam.

Dignity and beauty have been sought in the architectural treatment of the downstream face of the Kensico dam. Since the dam is divided for structural reasons by 22 expansion joints, its downstream face has 21 panels and two terminal structures. In its completed state the dam will be traversed by a public highway, which will approach from the east over a three-arch masonry bridge across a nearby waste channel of the reservoir.

In conclusion, a few of the more important figures in connection with the Kensico reservoir may be of interest, serving as they do toward an accurate conception of the magnitude of the undertaking. The total capacity of the reservoir is 38,000,000,000 gallons, with an available capacity of 29,000,000,000 gallons. The water surface will be 3.5 square miles, or 2,218 acres, while the land acquired for the reservoir totals 7 square miles, or 4,500 acres. The length of the reservoir is 4 miles, while the length of the shore line is 40 miles. The maximum width is 3 miles and the average width 1 mile. The elevation of the top of the dam above tide is 370 feet, with a maximum thickness at the base of 235 feet. The maximum thickness at the top is 28 feet. The maximum depth of the reservoir is 155 feet, with an average depth of 52 feet. In the construction of the reservoir 1,480,000 cubic yards of earth and rock were excavated. The embankment required 2,110,000 cubic yards. In the building of the reservoir 1,016,000 cubic yards of masonry was laid and 997,000 barrels of cement was used.

A New Form of the Fighting Aircraft

(*Concluded from page 513*)

an absolutely flat sea and clear weather. As the range of guns is likely to increase rather than diminish, I came to the conclusion that wireless torpedoes were 'out of it' for the reason I have described."

But Rear-Admiral Fiske has surmounted this difficulty. As he explains it, "In order to extend the usefulness of my invention to localities far from shore, my plan is to combine wireless control with my original scheme, in which a torpedo is dropped from an aeroplane. I would put the torpedo under one of the present giant aeroplanes and the latter to have a ship for its operative base. The seaplane would then fly with its weapon toward the enemy battleship or squadron, and when, let us say, four or five miles away from its objective, drop the torpedo into the water. The torpedo can then be guided by wireless, and the wireless control could be exercised either by a ship in the distance or else from another accompanying aircraft large enough to carry the necessary wireless apparatus. The latter seaplane would, of course, follow up the torpedo and keep it in sight well nigh until it had actually hit its target. In case, however, that the control wireless mechanism were aboard a ship, it would be necessary, of course, to inform the vessel how to steer the torpedo. For this purpose wireless on the aeroplane carrying the torpedo would answer.

"The dirigible torpedo should have bow and stern uprights for navigational guides and to support the wireless receiving outfit; but I do not think this arrangement would prevent the torpedo and its explosive charge from having a sufficient immersion. Of course, the uprights would cut down the speed somewhat, but dirigibility and the ability to work during the hours of darkness would more than offset this seeming handicap." The torpedo would be equipped with a

small light on each navigational upright, and these would be so screened that they could be seen only from the rear and upward from that position. The submarine is not an effective means of attack in the open sea at night, especially when the waters are troubled; nor, with up-to-date searchlights and with a battleship's screen of destroyers alert, can enemy destroyers hope to reach the capital ships by torpedo attack after nightfall. Rear-Admiral Fiske's employment of seaplanes for the carriage of dirigible torpedoes, thanks to what the catapult now promises, provides a way to surmount the protecting screen of destroyers and then to get inside of that line of defense and close enough to deliver a successful torpedo attack.

NEW BOOKS, ETC.

A TEXT-BOOK OF BACTERIOLOGY. A Practical Treatise for Students and Practitioners of Medicine. By Philip Hanson Hiss, Jr., M.D., and Hans Zinsser, M.D. New York: D. Appleton and Company, 1915. 8vo.; 766 pp.; 155 illustrations.

Those who have used this work in its first edition will find that its revision embodies the more important researches of the past three years; extensive changes and additions are found under such subjects as streptococci, plague, leprosy, syphilis, rabies, and poliomyelitis. New material appears under typhus fever and rat-leprosy. The new edition also takes account of Churchman's recent work on anilin dyes and bacterial growth, and of the Anderson and McClintic method of standardizing disinfectants. The beginner will find in the text the laws and technique of bacteriology as illustrated by their application to the study of pathogenic bacteria. In the section on immunity he is introduced in a simple, informal way to the more difficult problems of the field, and is given a basis for further reading. The text is peculiarly adapted to the medical student, and the full-fledged practitioner may also find it of value as a reference book and for review reading.

ELECTRICAL WIRING SPECIFICATIONS. By J. H. Montgomery, E.E. New York: D. Van Nostrand Company, 1915. 16mo.; 139 pp. Price, $1 net.

This little manual offers a helping hand to the architect or contractor faced by the necessity of drawing up specifications for electrical work. No attempt is made to include equipments of large size and special apparatus. Close attention to the instructions should enable a contractor to draw up a specification that states clearly and completely the exact work to be done; that indicates exactly the grade of workmanship; that defines the duties of the contractor, and that names approved materials so specifically that there is no chance for dispute. There are some practical rules for illumination that will give good results under ordinary circumstances, and some common sense instructions relating to inspection and superintendence.

PLANE GEOMETRY. By Claude Irwin Palmer, A.B., and Daniel Pomeroy Taylor, A.M. Edited by George William Myers, Ph.D. New York: Scott, Foresman and Company, 1915. 8vo.; 277 pp.; illustrated. Price, $1.

"Plane Geometry" aims at a real motivation of geometry on the part of the student; in other words, the authors bring to their task a sharp realization of the fact that the student should appreciate his task at its full value, and should gain a perfect insight as to its meaning. Geometry as a system of thought only attains its full usefulness when its spirit is appreciated. Thoroughly understood, it inculcates habits of reasoning and discrimination that may be applied to wider spheres; the scientific gain is obvious. Hence "Plane Geometry" stresses the usefulness of the study, and follows abstract exercises with concrete problems necessitating the application of the theoretical principles. The authors are high-school teachers of long experience, and their text is the residuum of manuscript layouts perfected through years of classroom work.

THE PRINCIPLES OF FLORICULTURE. By Edward A. White. New York: The Macmillan Company, 1915. 12mo.; 467 pp.; illustrated. Price, $1.75.

In this volume of the excellent Rural Text Book Series are set forth the principles underlying the successful culture of ornamental plants, and the mode of exposition makes the work available for either the classroom student or the practical man. The author sketches the development of our flower industry; discusses its centers and its markets; cites the factors influencing the selection of a location; and explains the construction and management of the modern greenhouse, suitable soils, the diseases to which greenhouse flowers are susceptible, and the insects that infest them. There are chapters on cut-flower crops and foliage plants, and on the packing and shipping of plants and flowers. In short, the book covers its chosen field thoroughly, and its appeal to all lovers of flowers is as strong as its helpfulness is indisputable.

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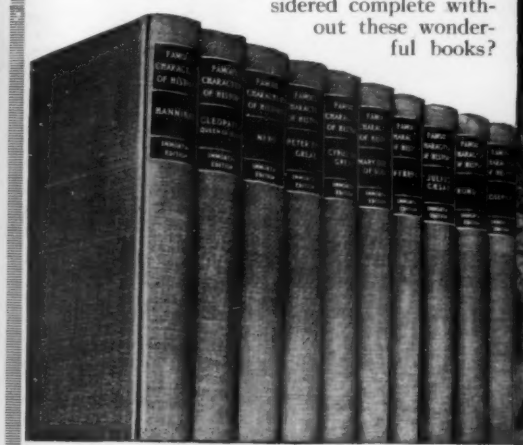

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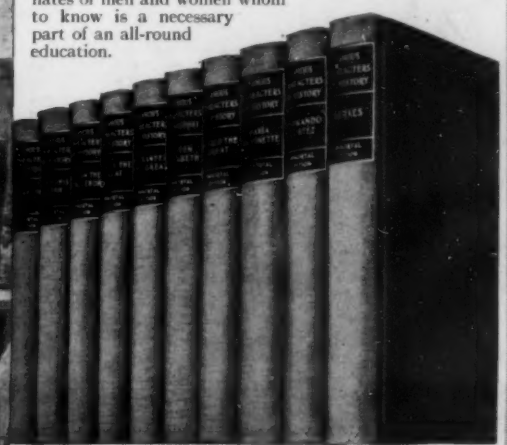

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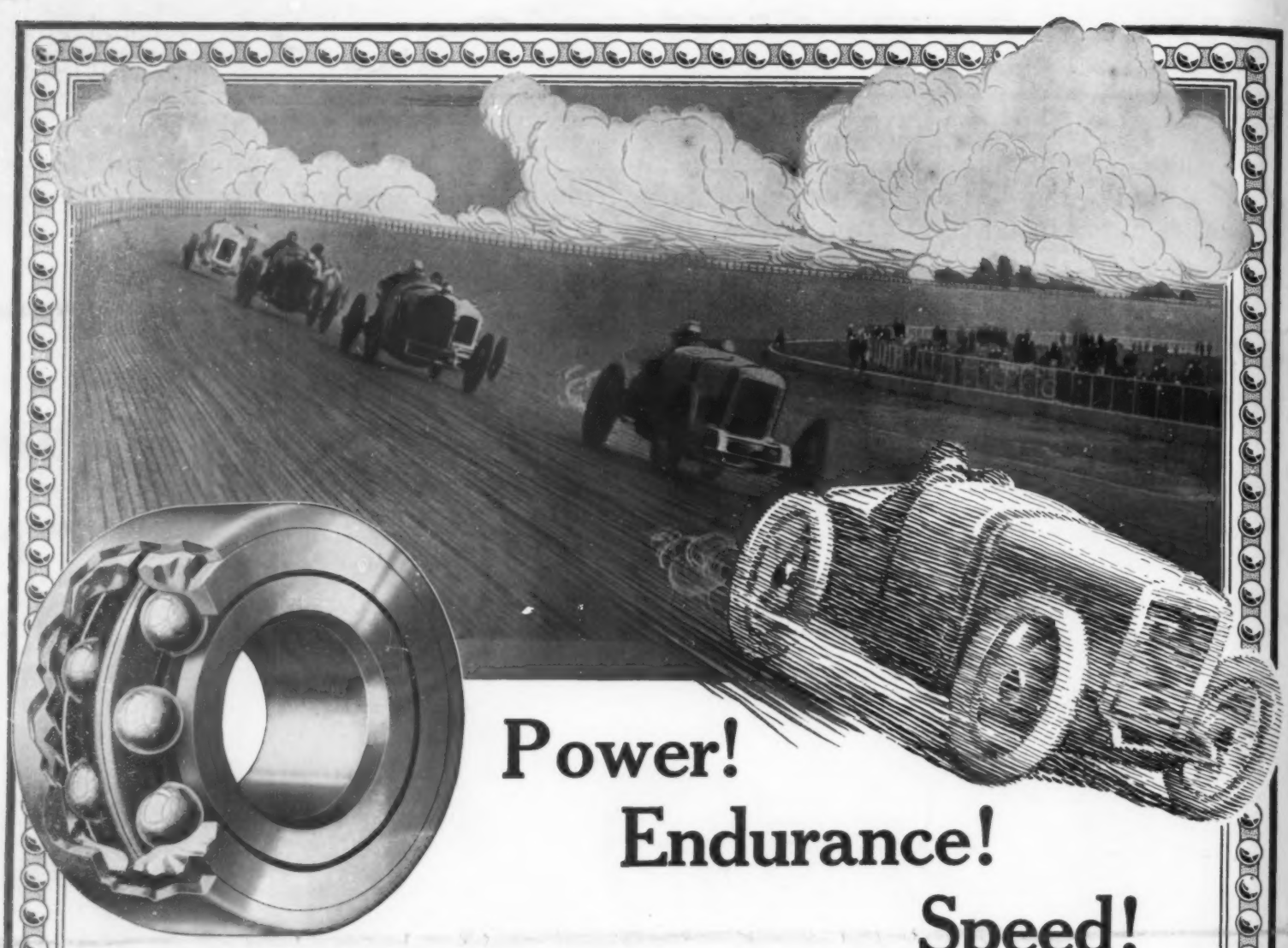

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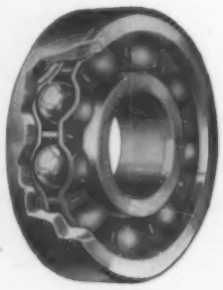

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